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THE DISTRIBUTION OF EXTRAGALACTIC NEBULAE, III*

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Abstract. Counts of extragalactic nebulae are tabulated for four of the nine areas comprising the program. Contour aps showing the distribution are given. The results of the counts for these four areas, plus those for two others previsly published, are used to derive a preliminary mean value of the galactic extinction toward the poles. The amount lculated from these new data is 0.46 mag., which is substantially larger than Hubble's generally accepted value of 25 mag.

The counts of extragalactic nebulae on plates .ken with the Carnegie 20-inch astrograph of ie Lick Observatory have been published for /o of the nine areas into which the sky obrvable from Mount Hamilton has been divided ;hane and Wirtanen 1954, Paper I; Shane 1956, iper II). The present paper, number III in the ries, gives the results for four additional areas. ıble I shows the present status of the work.

TABLE I. STATUS OF COUNTS

:a	Limits of α	Limits of δ	Remarks
	0^h, 6^h	$-20°$, $+20°$	This paper, Table V
	6^h, 12^h	$-20°$, $+20°$	This paper, Table VI
I	12^h, 18^h	$-20°$, $+20°$	*A. J.* **59**, 285, 1954; *L. O. Bull.*, No. 528
	18^h, 24^h	$-20°$, $+20°$	This paper, Table IV
	0^h, 6^h	$+20°$, $+60°$	*A. J.* 61, 292, 1956; *L. O. Bull.*, No. 543
	6^h, 12^h	$+20°$, $+60°$	Counted
I	12^h, 18^h	$+20°$, $+60°$	This paper, Table VII
II	18^h, 24^h	$+20°$, $+60°$	Counted
		$>+60°$	Counted

The uncorrected counts by square degrees for eas I, II, IV and VII are published in this per as Tables IV to VII inclusive. Plates in ch 5° zone of declination are tabulated as ›arate groups. The first line above each block the 36 counts on a single plate gives the plate mber and the right ascension of the plate ıter. The next line gives the initial of the server who counted the plate, S for Shane and for Wirtanen, followed by a small letter designating the plate emulsion, and finally the complete plate factor. A detailed description of the method used in making and reducing the counts is given in Paper I.

The reduced counts were obtained by multiplying each of the tabulated values, first by a field correction factor taken from Table II, second by an extinction factor whose logarithm equals 0.18 $(\sec z-1)$, and finally by the complete plate factor for the given plate. It is not worthwhile to list here the provisional values of the emulsion and personal factors used in calculating the complete plate factors, since these will be recomputed later on the basis of all nine areas.

The reduced counts were averaged by fours and used to draw the contour maps, Figures 1 to 4, which show the distribution of the extragalactic nebulae.

The discussion of the material in this paper is limited to a preliminary determination of the galactic extinction, and is based on these nebular counts in their present degree of completeness.

In his classic paper on "The Distribution of the Extragalactic Nebulae," Hubble (1934) fitted his counts to the equation

$$\log N = A + B \csc b, \qquad (1)$$

where N is the number of nebulae per square degree, b is the galactic latitude taken with a

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TABLE II. FIELD CORRECTIONS

Area I

1.12	1.04	1.03	1.07	1.16	1.34
1.01	0.96	0.98	1.02	1.06	1.20
0.96	0.95	0.98	1.02	1.06	1.15
0.96	0.95	0.98	1.02	1.06	1.15
1.01	0.96	0.98	1.02	1.06	1.20
1.12	1.04	1.03	1.07	1.16	1.34

Area II

1.17	1.07	1.05	1.08	1.19	1.38
1.04	0.97	0.98	1.02	1.07	1.23
0.98	0.95	0.98	1.02	1.05	1.16
0.98	0.95	0.98	1.02	1.05	1.16
1.04	0.97	0.98	1.02	1.07	1.23
1.17	1.07	1.05	1.08	1.19	1.38

Area IV

1.12	1.04	1.02	1.06	1.15	1.33
1.00	0.95	0.98	1.02	1.06	1.19
0.95	0.95	0.98	1.02	1.05	1.13
0.95	0.95	0.98	1.02	1.05	1.13
1.00	0.95	0.98	1.02	1.06	1.19
1.12	1.04	1.02	1.06	1.15	1.33

Area VII

1.15	1.06	1.04	1.08	1.17	1.37
1.02	0.97	0.98	1.02	1.07	1.21
0.97	0.95	0.98	1.02	1.05	1.15
0.97	0.95	0.98	1.02	1.05	1.15
1.02	0.97	0.98	1.02	1.07	1.21
1.15	1.06	1.04	1.08	1.17	1.37

positive sign, and A and B are constants determined empirically. This equation is based theoretically on an assumed large scale distribution of obscuring matter arranged symmetrically on either side of the galactic plane in uniform layers of infinite extent. Such a distribution of obscuring matter obviously does not closely approximate the real situation. Equation (1) is therefore to be regarded as an interpolation formula whose usefulness depends on the degree to which it fits the observations. When Hubble applied it to his data, the fit was good and yielded a value for B of -0.15, with no significant difference between separate determinations from the data north and south of the galactic plane. If Hubble's assumptions that for this purpose it is sufficiently accurate to neglect redshift effects, and that the nebulae are uniformly distributed in depth, then his analysis gave an extinction coefficient of $\frac{-B}{0.60}$, or 0.25 mag. for the optical half-thickness of the absorbing layer. This value has been widely used since the publication of Hubble's paper. The divisor 0.60 comes from the equation

$$\Delta \log N = 0.60\, \Delta m, \tag{2}$$

where $\Delta \log N$ is the change in $\log N$ corresponding to a change Δm in limiting magnitude. In a subsequent paper Hubble (1936) found empi cally that the factor should be 0.50 rather th 0.60. On this basis the extinction coefficie should have been increased to 0.30 mag.

In view of the empirical nature of equation (there is no assurance that A and B are ind pendent of galactic longitude. Hubble's coun were not extensive enough to investigate in det a possible dependence, although he briefly com mented on this possibility. The much mo complete counts of the current study shou permit separate determinations of A and B f different longitude intervals. Values of B f certain 20° longitude intervals were publish in Papers I and II of this series. With the e ception of a very poorly determined value $B = +0.05$, they range from -0.13 to $-0.$ with an unweighted mean of -0.37. This val is more than twice that derived by Hubble, b it is strongly affected by several large valu from areas near the longitude of the centr galactic bulge. Nevertheless, it seems probab that Hubble's value of B should be revis upward.

To determine B for a given longitude interv with sufficient accuracy, the counts should cov a large range of latitude. This requirement ca not generally be fulfilled with the material ava able to date, since the full latitude range usual extends into two or more of our nine areas. A shown below, counts of the different areas exten to somewhat different limiting magnitudes th are not well determined. At present, therefor it is impossible to combine counts in the differen areas in a solution for B. In this paper eac determination must be limited to data from particular area, but a more definitive reductio will be made from all areas when the counts hav been completed and reduced to a common limi ing magnitude.

The data used in the solutions were the mea values of the corrected counts for each plate wi its center in the area for which the solution wa made. In forming the means, the four corn square degrees were given weight 1/4, and th sixteen along the edges weight 1/2, as compare with unity for the sixteen central square degree This weighting was used because, to a fair appro imation, the corner square degrees are counte on four plates and the other edge square degre on two. Thus the overweighting of certain squa degrees due to the overlaps is largely avoide

The plate factor, an average field factor, an the zenith extinction corrections were applie

the counts, and the log of the mean N for ch plate together with the cosecant of the lactic latitude of the plate center were substi- ted in equation (1). Least squares solutions r the six areas thus far reduced were made om these observation equations.

Two sets of solutions were carried out. In the st set only plates with $|b| > 39°$ were used. the second set all plates with mean $N > 10$ re included. The first set of solutions avoids me strong absorbing clouds in low latitude, t it has small weight for the determination of because of the restricted range in sec b. With is small range of sec b, the large-scale irregu- ities in the distribution of the extragalactic bulae, as well as possible obscuring areas in gh latitudes, may seriously affect the derived lue of B. On the other hand, $A + B$, which presents the logarithm of the number of nebu- extrapolated to the pole, should be fairly curate.

In the second set of solutions, conspicuous al clouds of obscuration in low latitudes should ve a disturbing effect on some of the results, t to omit the regions of their occurrence would d to introduce bias. These second-set solu- ns seem, on the whole, to be considerably more curate for determining the galactic extinction, and to be equally reliable with the first set determining $A + B$.

The limiting photographic magnitude based Hubble's scale was derived by comparing our unts with Hubble's as explained in Paper I of is series. It is known that this scale has sub- ntial errors, but there is no evidence suggesting at it is not consistent over the sky. On the her hand, our areas were in general counted in quence, though not in the order of their num- red designations. It is therefore reasonable expect the counts in them to have different niting magnitudes due to changing personal uations.

The values of B and $A + B$ for the six areas together with the limiting magnitudes are contained in Table III. The letter "n" or "s" in the first column indicates that the area is predominantly north or south of the galactic equator. The values "$(A + B)$ corr." in the fifth and eighth columns are derived from their immediately preceding columns by reduction to the mean limiting photographic magnitude of 18.19. The other columns are self-explanatory.

The large range in B calculated from latitudes above 39° is evidence of the low weight of these determinations. The average weight of the five values, as computed formally in the course of the least squares solutions, is 2, which may be compared with 31 as the average weight for the B's in the sixth column. These formal weights do not, however, give a correct impression of the accuracy. There are large scale irregularities in the apparent distribution of the nebulae that can strongly affect B as calculated over a limited portion of the sky. Perhaps the most striking instance in high latitudes is a region of low counts around the north galactic pole and extending toward lower latitudes in the direction of longitude 90°. The Coma cluster of nebulae lies in this relatively sparse area. Other regions of low as well as of abnormally high counts are readily found on the charts.

The values of B in the sixth column, determined for all latitudes higher than the $N = 10$ contour, are more consistent, although the range is still large. An area such as III, which includes the galactic bulge, would be expected to yield a high value.

It is interesting to note that the mean B's for north and south latitudes are nearly the same. The small excess for north latitudes is easily accounted for by the inclusion of Area III with no compensating area in south latitudes near the galactic bulge. There is thus no evidence from the galactic extinction coefficients that the sun

TABLE III. VALUES B AND $A + B$

Area	Lim. mag.	$\|b\| > 39°$ B	$\|b\| > 39°$ $A + B$	$\|b\| > 39°$ $(A + B)$ Corr.	$\|b\| > 0°$ B	$\|b\| > 0°$ $A + B$	$\|b\| > 0°$ $(A + B)$ Corr.
I s	18.24	−0.44	1.82	1.79	−0.25	1.77	1.74
II n	18.02	−0.24	1.81	1.90	−0.21	1.77	1.86
III n	18.30	−0.32	1.88	1.82	−0.42	1.88	1.82
IV s	18.04	−0.04	1.62	1.70	−0.26	1.67	1.75
V s	18.23				−0.14	1.81	1.79
VII n	18.30	−0.05	1.71	1.65	−0.19	1.74	1.68
Mean, N lat.	—	−0.20	1.80	1.79	−0.27	1.80	1.79
Mean, S lat.	—	−0.24	1.72	1.74	−0.22	1.75	1.76
Mean, all lat.	18.19	−0.22	1.77	1.77	−0.24	1.77	1.77

TABLE IV. AREA IV, UNCORRECTED COUNTS OF NEBULAE PER SQUARE DEGREE

δ = -20°

487 $18^h\,00^m$ Sa 0.957

0	0	0	0	0	0
0	0	0	1	0	0
0	0	0	0	0	0
0	0	0	0	2	0
0	0	0	0	0	0
0	1	0	0	0	0

921 $18^h\,20^m$ Wb 0.767

0	2	0	0	1	0
4	0	2	0	0	2
0	1	1	0	0	0
0	1	1	0	0	1
0	0	0	0	0	0
0	0	1	2	3	8

554 $18^h\,40^m$ Wa 0.734

0	0	0	0	1	0
0	0	1	0	1	1
1	0	0	0	0	0
2	0	1	0	0	2
0	0	0	1	0	1
1	0	4	1	1	0

563 $19^h\,00^m$ Wa 0.734

5	0	1	0	0	[illegible]
4	4	0	0	0	[illegible]
3	0	1	1	4	[illegible]
0	1	3	0	1	[illegible]
3	0	0	0	1	[illegible]
3	1	2	1	0	[illegible]

889 $19^h\,20^m$ Sb 1.000

2	3	1	3	1	3
7	2	2	2	2	5
2	3	3	2	4	3
9	7	4	1	3	1
2	5	0	4	2	1
1	2	2	2	3	0

522 $19^h\,40^m$ Sa 1.320

2	2	5	3	5	3
4	9	3	9	4	8
8	5	8	6	2	2
6	3	1	4	8	8
4	5	7	2	2	2
4	5	4	7	2	3

1683 $20^h\,00^m$ Wi 0.567

20	10	6	7	6	5
25	15	9	9	16	12
20	9	9	7	12	10
16	32	23	10	7	9
30	40	16	19	20	14
17	15	8	23	10	19

528 $20^h\,20^m$ Sa 1.113

3	13	9	9	7	12
14	11	20	16	9	10
27	32	14	17	21	6
21	22	27	21	15	11
18	16	68	14	14	8
8	13	9	18	7	3

925 $20^h\,40^m$ Sb 1.156

4	17	12	19	6	[illegible]
10	31	25	10	10	[illegible]
10	14	16	11	6	[illegible]
4	22	19	43	14	[illegible]
9	5	7	18	11	[illegible]
14	15	11	6	4	[illegible]

561 $21^h\,00^m$ Sa 1.000

7	5	12	23	13	7
7	8	15	18	30	12
12	11	11	14	22	8
31	19	14	15	15	9
24	30	29	23	15	9
6	9	19	20	7	12

564 $21^h\,20^m$ Wa 0.716

23	19	16	17	14	12
21	41	25	10	16	15
51	65	27	31	34	25
28	29	43	47	19	43
31	46	39	38	27	29
35	44	41	48	35	28

1021 $21^h\,40^m$ Sd 1.113

45	37	40	40	27	25
33	32	46	29	21	22
52	40	38	28	25	32
35	58	56	37	26	30
46	61	48	54	41	31
31	32	31	30	40	25

1408 $22^h\,00^m$ Wg 0.669

54	45	58	71	54	43
49	59	39	69	75	35
70	61	67	82	77	84
61	59	80	120	90	74
43	77	115	73	58	76
68	61	107	93	39	60

673 $22^h\,20^m$ Sb 0.879

48	49	43	28	47	[illegible]
45	41	52	31	66	[illegible]
52	57	34	30	45	[illegible]
45	34	24	37	21	[illegible]
26	32	32	20	31	[illegible]
43	40	24	32	39	[illegible]

658 $22^h\,40^m$ Wb 0.976

40	43	56	44	40	32
51	44	38	32	22	23
41	38	16	36	36	29
41	31	27	23	38	27
20	36	27	33	32	24
15	29	18	30	32	23

1764 $23^h\,00^m$ Wi 0.778

12	29	34	12	27	20
28	27	18	17	12	38
38	27	30	16	23	44
32	72	27	19	20	50
56	45	36	24	30	22
21	35	20	17	16	12

562 $23^h\,20^m$ Wa 1.065

20	10	7	15	12	13
23	27	13	28	23	25
22	23	22	16	28	13
37	19	24	33	31	20
34	28	15	37	31	41
15	25	37	36	31	21

565 $23^h\,40^m$ Wa 0.701

43	36	26	26	50	20
48	28	23	25	27	25
39	56	42	27	34	28
50	51	34	37	20	46
41	42	38	29	26	29
36	31	40	52	46	32

977 $0^h\,00^m$ Wd 0.982

13	26	27	33	26	[illegible]
26	24	40	23	42	[illegible]
40	20	26	17	43	[illegible]
27	37	21	36	42	[illegible]
18	30	28	40	32	[illegible]
26	22	26	25	29	[illegible]

δ = -15°

505 $18^h\,00^m$ Sa 0.957

0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	1	0	0	0
0	0	0	0	0	0

531 $18^h\,20^m$ Wa 0.734

2	0	2	2	3	7
0	0	0	0	1	0
0	0	0	0	1	1
1	0	0	1	0	1
0	0	0	0	0	1
4	4	1	1	4	4

560 $18^h\,40^m$ Wa 0.734

0	0	3	2	0	1
1	0	0	0	1	0
0	0	0	0	0	0
0	0	0	0	1	0
0	0	0	0	0	0
1	2	1	0	0	0

875 $19^h\,00^m$ Wb 0.767

0	0	1	0	0	[illegible]
0	1	0	0	0	[illegible]
2	0	0	0	1	[illegible]
0	0	1	0	0	[illegible]
1	2	0	0	1	[illegible]
2	2	0	0	1	[illegible]

892 $19^h\,20^m$ Sb 1.000

0	1	1	0	1	0
1	2	1	1	0	1
1	3	0	2	2	2
4	4	2	0	3	1
1	1	2	3	2	2
3	3	1	2	4	2

530 $19^h\,40^m$ Sa 0.957

5	8	3	2	4	0
3	2	3	2	4	2
1	7	4	1	1	1
3	3	1	2	3	6
5	0	5	2	0	1
4	1	5	4	4	2

1330 $20^h\,00^m$ Sf 1.266

4	6	5	6	7	5
7	6	3	4	3	5
13	6	4	4	1	2
3	8	5	3	1	3
7	2	8	2	6	3
14	5	7	6	2	1

536 $20^h\,20^m$ Wa 0.482

23	20	12	15	19	12
25	22	17	11	17	13
10	13	13	16	23	19
24	10	11	33	12	11
5	14	11	9	7	17
14	27	27	16	19	20

926 $20^h\,40^m$ Sb 1.061

10	19	19	16	10	[illegible]
9	15	16	2	16	[illegible]
13	22	9	9	11	[illegible]
6	10	13	8	11	[illegible]
24	8	9	11	12	[illegible]
6	21	19	26	4	[illegible]

896 $21^h\,00^m$ Sb 1.235

13	9	25	9	6	4
7	22	21	37	5	10
5	22	33	60	20	5
13	16	16	17	17	4
2	10	16	20	11	15
9	6	13	16	17	3

559 $21^h\,20^m$ Sa 1.105

18	10	18	25	17	13
31	31	20	23	8	7
14	11	21	15	7	5
16	14	14	14	9	11
25	22	15	13	10	8
18	15	10	12	8	8

1316 $21^h\,40^m$ Wf 0.628

75	46	41	22	31	43
78	62	32	33	26	72
57	67	43	71	32	23
135	56	47	30	27	24
83	39	67	79	33	57
59	52	58	60	43	41

1702 $22^h\,00^m$ Si 1.154

46	88	51	42	72	58
52	55	39	45	40	60
23	18	44	54	49	57
25	23	47	51	56	94
43	36	39	35	41	36
21	16	28	30	24	23

1287 $22^h\,20^m$ Wf 0.804

50	68	58	58	37	[illegible]
29	20	51	42	54	[illegible]
48	28	42	38	38	[illegible]
46	29	22	28	43	[illegible]
43	40	42	60	68	[illegible]
49	54	59	34	63	[illegible]

1282 $22^h\,40^m$ Sf 0.727

21	23	20	29	42	19
31	27	24	30	48	15
37	26	34	33	37	33
38	35	27	24	74	47
55	51	64	63	79	39
47	53	74	58	52	40

927 $23^h\,00^m$ Wb 1.173

56	46	30	26	20	19
48	36	49	29	35	17
41	18	21	16	28	14
24	31	23	34	26	24
18	28	23	35	36	30
18	36	37	16	24	22

960 $23^h\,20^m$ Wd 0.634

25	57	68	32	42	54
38	73	54	37	45	59
41	53	32	24	36	37
34	31	24	30	20	24
37	31	44	30	21	36
32	28	21	29	31	22

1776 $23^h\,40^m$ Wi 0.722

28	37	31	37	34	26
53	39	24	35	25	48
45	56	29	38	37	50
60	64	51	76	49	35
45	45	30	49	44	36
39	36	37	31	58	28

979 $0^h\,00^m$ Wd 0.954

24	23	25	23	13	[illegible]
25	14	35	18	16	[illegible]
16	15	20	32	18	[illegible]
18	28	34	39	37	[illegible]
34	27	37	45	42	[illegible]
24	30	30	40	28	[illegible]

TABLE IV. (continued)

δ = -10°

499 $18^h 00^m$ Sa 0.957

1	1	1	0	0	0
0	1	0	0	0	0
0	0	0	0	0	1
0	0	0	0	0	0
0	1	0	0	0	0
0	0	0	0	0	0

931 $18^h 20^m$ Wc 0.734

1	3	3	3	4	6
2	2	0	2	2	4
2	3	3	0	1	7
0	0	0	0	2	3
0	0	0	0	0	0
1	0	1	0	1	1

1265 $18^h 40^m$ Wf 0.815

1	0	0	0	2	0
0	0	0	0	0	0
0	1	0	0	1	0
1	1	0	0	1	1
0	0	0	0	1	0
1	0	1	0	0	1

515 $19^h 00^m$ Sa 0.957

0	0	0	0	0	0
1	0	1	1	0	0
2	0	0	0	0	0
1	0	0	0	0	0
1	0	0	0	0	0
0	0	1	0	3	1

864 $19^h 20^m$ Sb 1.000

4	6	2	0	5	0
4	3	2	0	1	1
1	1	0	1	0	0
1	0	0	0	1	0
2	5	3	2	1	0
2	1	1	5	0	1

1288 $19^h 40^m$ Sf 0.836

2	4	6	0	2	3
9	9	3	1	2	3
7	5	5	0	2	1
11	8	4	4	4	1
9	6	3	2	2	0
10	9	3	3	4	3

1286 $20^h 00^m$ Sf 1.034

2	3	1	2	5	4
18	8	15	2	7	7
10	7	7	5	6	3
8	6	18	3	8	2
6	7	0	4	7	7
5	10	11	2	12	4

895 $20^h 20^m$ Sb 1.367

5	3	9	11	5	2
11	15	13	17	16	9
9	7	31	6	13	13
6	7	9	12	6	5
10	12	12	3	4	7
5	9	6	8	8	4

930 $20^h 40^m$ Wc 0.544

19	16	12	27	18	8
20	19	17	23	24	26
27	16	18	18	25	17
24	24	22	16	17	14
23	33	37	23	12	26
22	25	48	24	15	19

1701 $21^h 00^m$ Si 0.956

16	12	29	31	32	9
16	18	44	25	27	11
23	31	32	35	24	10
17	30	31	17	22	8
16	25	15	14	18	7
19	23	27	20	8	7

557 $21^h 20^m$ Sa 1.129

19	16	25	11	17	8
43	18	16	9	12	10
22	21	11	14	12	10
29	10	12	11	10	5
9	26	23	9	19	10
20	15	6	22	14	14

1725 $21^h 40^m$ Si 1.161

59	41	62	38	28	19
42	46	59	53	35	43
41	21	52	34	36	23
40	68	80	32	37	33
17	36	21	16	22	14
41	28	23	6	13	17

1289 $22^h 00^m$ Wf 0.753

28	70	52	59	96	87
64	69	56	87	135	79
69	85	78	62	102	41
112	108	121	96	94	58
50	54	57	82	61	33
48	76	62	53	76	56

1325 $22^h 20^m$ Sf 1.043

13	24	22	19	29	17
54	45	48	32	47	38
42	52	37	32	44	46
29	35	27	37	90	83
37	44	38	23	24	43
33	46	45	57	21	36

1285 $22^h 40^m$ Wf 0.993

17	25	31	28	42	12
30	36	47	40	26	39
41	33	36	27	33	45
55	18	29	23	29	25
42	41	28	28	17	33
19	19	13	28	36	26

1747* $23^h 00^m$ Si 0.763

25	34	42	46	33	14
34	46	55	77	42	31
39	50	43	54	43	30
56	38	65	56	29	63
39	97	60	46	50	45
63	53	48	39	28	17

1001 $23^h 20^m$ Wd 1.065

25	18	25	18	27	29
26	16	29	28	34	36
34	59	28	22	36	21
23	36	60	43	30	26
47	27	43	24	26	36
24	48	44	30	29	43

662 $23^h 40^m$ Wb 0.724

37	49	64	44	30	31
37	29	53	44	23	28
29	30	34	26	44	28
81	32	30	40	38	23
59	35	29	52	39	37
36	45	27	41	39	43

1086 $0^h 00^m$ We 0.648

59	36	57	76	49	53
42	40	47	49	64	39
26	26	39	50	85	23
52	44	57	47	78	92
60	38	57	51	56	78
35	43	38	35	27	40

δ = -5°

509 $18^h 00^m$ Sa 0.914

0	0	0	0	0	1
0	0	0	0	0	0
1	0	0	0	0	0
1	0	0	1	0	1
0	1	0	0	0	1
0	0	0	0	0	0

918 $18^h 20^m$ Wb 0.767

2	0	1	0	1	0
5	0	1	0	0	1
3	1	0	0	0	0
1	1	0	1	2	3
3	2	1	3	0	5
2	0	1	1	0	0

1656 $18^h 40^m$ Wi 0.780

0	0	0	1	0	0
0	0	1	0	2	0
0	0	0	0	0	0
0	0	0	0	0	0
1	1	0	1	0	0
0	0	0	0	0	0

558 $19^h 00^m$ Wa 0.734

0	2	2	1	0	1
2	1	0	0	1	0
0	1	0	0	0	1
0	0	0	0	0	0
1	0	0	0	0	1
1	2	2	0	0	0

1315 $19^h 20^m$ Sf 1.062

0	1	1	0	0	0
1	2	0	0	0	0
0	0	0	1	0	2
2	1	0	0	0	0
2	2	1	0	0	2
2	0	1	0	1	1

1678 $19^h 40^m$ Si 1.016

5	2	0	0	2	2
3	0	1	3	0	1
0	1	1	0	0	0
4	7	1	0	0	1
1	7	8	5	8	1
1	4	4	1	2	2

1290 $20^h 00^m$ Sf 1.062

2	0	4	0	3	1
2	5	1	2	2	2
4	4	1	3	2	0
2	5	1	2	2	0
3	4	3	5	5	0
4	9	2	5	3	1

1269 $20^h 20^m$ Sf 0.985

13	8	13	5	1	1
7	15	6	7	7	3
10	9	7	2	5	2
11	6	11	6	4	2
4	11	8	9	7	1
6	3	9	9	3	3

932 $20^h 40^m$ Sc 1.519

8	6	18	6	12	13
19	14	18	17	10	6
8	21	23	11	8	6
10	6	12	14	0	4
6	10	9	8	12	5
8	8	9	14	10	3

1693 $21^h 00^m$ Wi 0.602

32	33	19	28	21	23
32	33	21	30	30	37
15	24	30	45	42	23
25	29	26	41	33	15
21	27	33	34	24	8
31	30	31	43	39	19

567 $21^h 20^m$ Sa 1.296

23	10	12	15	11	16
8	12	7	21	10	17
15	14	13	19	17	7
25	20	18	23	14	10
11	20	10	10	11	5
15	14	31	9	14	4

1347 $21^h 40^m$ Sg 1.072

12	21	15	18	14	18
37	17	20	19	23	7
28	23	29	33	25	14
41	40	41	39	20	25
62	47	47	32	20	15
66	50	58	38	23	14

1328 $22^h 00^m$ Sf 1.227

29	32	21	24	19	20
18	9	17	15	28	37
30	25	24	24	35	26
17	32	57	41	23	24
24	29	52	30	42	29
20	66	41	52	76	47

1291 $22^h 20^m$ Wf 0.678

32	32	93	41	41	50
25	36	60	120	91	40
32	27	29	63	105	42
36	18	30	25	42	39
41	34	39	28	29	31
22	30	29	38	26	33

1739 $22^h 40^m$ Si 1.277

17	15	25	15	18	15
20	50	33	23	33	13
41	51	30	20	18	9
37	46	73	12	27	22
24	24	30	31	15	26
20	18	23	23	28	10

1430 $23^h 00^m$ Wg 0.896

46	29	18	25	41	26
42	51	33	41	33	28
32	33	44	41	40	47
36	37	35	35	27	39
17	30	30	34	43	29
20	28	28	43	33	21

1714 $23^h 20^m$ Si 0.849

49	70	45	44	77	34
41	39	35	31	36	30
32	18	17	34	17	26
26	19	27	32	38	23
30	21	24	20	27	19
30	22	28	29	20	18

568 $23^h 40^m$ Wa 0.846

39	73	47	33	34	44
55	38	35	45	43	37
43	41	72	43	44	22
35	32	50	33	33	17
30	36	49	42	18	20
31	38	58	32	19	17

1320 $0^h 00^m$ Wf 0.903

29	41	36	39	43	27
40	44	38	48	54	49
28	23	26	44	34	30
43	26	21	36	25	36
61	32	33	22	44	18
44	27	33	53	38	31

TABLE IV. (continued)

δ = 0°

514 $18^h 00^m$
Sa 0.957

0	0	3	1	3	0
1	1	1	1	2	1
0	0	0	0	2	2
1	0	1	2	2	1
0	0	1	0	1	1
0	0	0	0	1	0

924 $18^h 20^m$
Wb 0.767

1	0	0	2	0	1
1	0	2	0	0	1
0	0	0	0	0	0
1	0	0	0	1	2
1	0	0	0	2	1
0	0	0	1	0	0

1696 $18^h 40^m$
Wi 0.780

0	1	0	0	0	1
0	2	0	0	0	1
2	2	0	0	0	0
0	0	0	1	0	0
1	1	0	0	0	0
0	0	0	0	0	0

520 $19^h 00^m$
Sa 0.957

0	1	1	0	0	0
0	0	0	1	0	0
0	0	0	0	0	0
0	0	0	0	0	0
1	0	0	0	0	0
2	0	1	0	2	0

510 $19^h 20^m$
Wa 0.734

2	0	0	2	1	0
4	0	0	2	2	3
1	1	0	0	1	6
0	2	1	0	0	2
1	2	1	0	0	2
1	1	1	0	3	5

1276 $19^h 40^m$
Sf 1.062

2	2	2	1	4	0
3	1	0	3	0	1
1	2	3	0	1	2
1	0	2	1	1	0
2	0	2	1	1	1
1	1	0	0	0	1

1324 $20^h 00^m$
Sf 1.062

9	10	1	3	5	1
10	4	14	11	6	1
4	12	5	4	0	1
7	7	2	4	5	1
3	12	5	0	4	1
3	4	4	3	5	3

1281 $20^h 20^m$
Sf 1.006

14	11	18	7	7	6
8	12	13	6	4	6
4	11	5	12	2	6
3	13	8	20	13	5
11	24	4	16	6	2
14	10	8	4	2	2

1357 $20^h 40^m$
Sg 0.958

7	5	7	9	7	9
7	4	9	14	19	10
13	21	11	12	3	6
27	13	8	10	6	5
23	29	24	13	7	13
24	10	26	14	17	17

2014 $21^h 00^m$
Sk 1.276

43	7	6	13	11	7
17	13	7	14	6	9
12	23	20	16	11	12
36	28	24	30	25	20
26	24	19	8	12	8
24	32	15	24	7	10

570 $21^h 20^m$
Sa 0.892

18	32	29	29	31	56
29	45	48	39	19	20
38	42	41	26	28	13
48	52	27	19	39	34
28	45	8	34	18	27
30	20	10	19	19	20

1004 $21^h 40^m$
Sd 1.110

38	14	16	16	16	23
10	12	21	13	30	14
20	33	19	32	47	19
19	18	15	31	28	22
20	23	30	24	21	24
23	31	28	29	29	17

1277** $22^h 00^m$
Sf 2.255

10	6	22	12	6	18
15	21	27	14	15	4
16	16	21	12	10	6
17	12	17	15	8	6
9	10	8	10	10	9
6	11	3	16	4	4

1331 $22^h 20^m$
Sf 1.205

25	20	35	30	35	17
28	29	23	24	19	22
46	38	25	19	18	23
23	48	26	11	28	19
28	35	47	27	20	14
20	24	65	27	30	20

1428 $22^h 40^m$
Wg 0.577

41	44	39	42	49	51
40	60	73	40	122	47
79	46	105	48	54	87
38	40	49	50	34	44
42	27	59	89	55	44
42	39	62	34	44	35

1717 $23^h 00^m$
Si 1.057

19	21	26	30	17	11
14	17	37	29	31	18
22	24	33	31	39	51
37	44	20	27	38	28
25	34	15	20	31	23
32	22	20	18	37	18

1775 $23^h 20^m$
Wi 0.959

27	18	30	32	31	26
27	40	33	49	31	18
29	19	28	31	39	18
42	20	25	23	27	30
44	34	28	37	34	22
55	72	43	50	80	42

654 $23^h 40^m$
Wb 0.700

54	36	38	33	34	37
52	60	35	24	59	38
38	32	40	29	50	40
42	20	48	64	63	59
48	33	32	37	59	80
33	75	40	20	23	41

981** $0^h 00^m$
Wd 1.483

24	25	16	23	22	22
28	21	32	20	30	22
40	30	54	38	36	22
42	42	23	22	23	13
31	42	20	20	63	14
18	34	38	30	33	26

δ = +5°

913 $18^h 00^m$
Sb 1.000

4	2	3	2	2	1
2	6	1	3	1	6
2	2	2	2	2	3
3	4	4	1	0	2
2	0	1	3	4	0
5	1	4	4	3	3

1261 $18^h 20^m$
Wf 0.813

1	1	0	1	3	8
1	4	1	6	2	5
5	1	0	3	2	2
2	0	0	0	2	3
5	1	1	1	2	1
2	3	0	0	0	0

1700 $18^h 40^m$
Wi 0.780

1	0	0	1	1	0
0	1	0	2	1	0
0	0	0	0	0	0
0	0	0	0	0	0
1	0	1	1	2	0
0	1	0	0	1	1

566 $19^h 00^m$
Wa 0.734

0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	1
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

1318 $19^h 20^m$
Sf 1.062

0	0	0	2	0	0
0	0	0	0	0	0
1	1	0	0	0	0
0	0	0	2	0	1
0	0	1	0	1	1
2	0	1	1	0	1

1321 $19^h 40^m$
Wf 0.813

0	0	1	0	0	0
0	1	0	1	1	2
5	3	1	0	0	1
11	4	2	0	3	0
2	7	1	2	0	1
0	4	3	4	7	3

1344 $20^h 00^m$
Sg 0.824

5	6	7	0	2	0
5	4	10	3	1	0
5	8	1	3	9	2
7	9	1	1	3	4
13	13	3	1	0	2
8	6	1	2	2	1

1284 $20^h 20^m$
Wf 1.140

6	3	6	11	4	5
6	1	9	8	5	2
6	4	5	5	4	7
10	4	5	4	5	4
5	7	8	5	3	6
14	11	15	2	6	9

1969 $20^h 40^m$
Sk 0.911

16	22	11	12	6	7
19	9	16	12	6	4
8	15	28	6	5	5
7	8	13	4	8	10
13	17	6	11	10	4
9	9	16	12	7	14

1690 $21^h 00^m$
Si 1.013

14	25	17	28	7	14
20	19	22	14	12	26
17	19	27	14	9	7
23	21	12	12	13	13
14	16	13	13	12	7
68	21	12	18	12	12

649 $21^h 20^m$
Sb 0.883

23	33	23	18	25	21
21	43	27	37	30	22
33	41	34	30	29	19
47	50	56	20	23	25
85	68	50	36	18	23
28	46	40	41	31	45

546 $21^h 40^m$
Sa 0.886

40	25	22	19	27	23
24	26	35	39	33	22
22	18	27	32	34	39
41	41	29	39	20	34
59	23	10	16	23	39
53	22	27	19	19	29

1027 $22^h 00^m$
Wd 1.208

20	14	15	15	17	23
26	15	12	22	33	10
18	4	19	13	14	11
25	20	25	13	20	24
13	20	14	14	21	41
15	14	27	16	14	37

1731 $22^h 20^m$
Si 0.953

11	18	20	18	21	27
21	25	20	23	11	22
30	22	23	25	19	13
19	26	31	19	18	24
25	26	38	15	25	15
30	21	51	27	26	12

1770 $22^h 40^m$
Si 1.304

22	24	20	29	9	6
24	20	25	25	13	9
44	36	19	32	28	19
27	44	25	21	23	9
51	33	40	20	19	27
20	30	24	27	32	22

1720 $23^h 00^m$
Wi 0.816

64	87	44	51	29	25
53	42	32	89	34	34
47	58	30	41	26	53
23	51	24	30	39	35
49	37	40	42	51	47
31	25	28	31	16	20

1778 $23^h 20^m$
Si 0.954

22	24	24	47	42	33
21	33	47	39	50	49
26	21	26	26	35	39
31	25	38	33	30	17
35	44	27	34	29	35
23	17	38	38	34	17

1427 $23^h 40^m$
Wg 1.091

26	30	14	21	30	29
67	37	8	19	24	20
48	39	31	25	21	20
16	17	22	21	26	23
35	29	24	24	23	34
45	25	36	15	29	21

1726 $0^h 00^m$
Wi 0.704

21	31	46	68	33	45
42	62	57	55	38	71
54	58	74	79	74	74
56	77	92	49	41	34
58	79	72	73	71	59
49	56	48	42	42	51

TABLE IV (continued)

δ = +10°

915	$18^h\,00^m$				
S b	1.155				
7	6	6	5	10	5
6	6	13	3	6	2
5	7	11	15	2	3
2	12	5	2	2	1
1	5	3	1	5	1
2	0	2	2	5	0

1654	$18^h\,20^m$				
W i	0.779				
3	4	6	0	10	6
2	6	3	2	9	7
1	4	2	1	2	3
3	0	1	2	0	3
2	1	0	1	1	1
5	1	5	3	6	2

1692	$18^h\,40^m$				
W i	0.779				
0	0	1	0	0	1
0	0	1	0	1	1
1	1	0	0	3	0
0	0	0	0	0	1
1	1	0	0	0	0
1	1	0	0	0	0

877	$19^h\,00^m$				
S b	1.000				
0	0	3	2	3	2
0	0	0	2	0	1
0	1	0	2	0	0
0	1	0	0	2	2
0	0	1	0	0	0
1	0	0	2	0	0

882	$19^h\,20^m$				
W b	0.767				
1	1	0	2	0	0
0	0	0	0	0	0
0	1	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	1	0	0

1327	$19^h\,40^m$				
S f	1.062				
0	0	0	0	0	0
0	0	0	0	0	0
1	0	0	0	0	1
0	1	0	0	0	0
4	0	2	0	0	0
1	0	1	0	0	0

1345	$20^h\,00^m$				
W g	0.832				
3	2	1	0	2	0
2	0	1	0	0	0
4	3	1	1	0	1
4	1	1	0	0	0
2	2	0	1	1	4
7	2	6	0	2	1

2011	$20^h\,20^m$				
S k	0.851				
7	3	7	1	2	3
6	6	5	1	2	2
9	14	10	2	2	4
16	4	9	4	2	4
9	9	8	4	5	2
9	6	6	11	6	6

1365	$20^h\,40^m$				
W g	1.144				
2	6	15	10	6	5
11	14	10	6	4	9
11	10	9	24	19	5
11	12	14	12	9	17
6	12	7	16	9	8
8	17	18	16	4	10

959	$21^h\,00^m$				
S d	0.877				
4	26	34	19	17	9
0	25	39	21	21	13
7	15	20	31	18	9
2	17	18	20	20	11
0	27	30	26	17	8
7	28	33	29	12	18

897	$21^h\,20^m$				
S b	1.204				
18	22	18	16	25	34
34	21	8	20	9	20
59	40	17	27	27	14
36	45	25	30	24	10
38	31	18	32	10	14
21	27	20	15	28	14

993	$21^h\,40^m$				
S d	1.174				
26	19	14	21	21	23
13	14	17	17	33	40
14	23	22	57	39	41
31	27	44	31	35	48
51	31	19	27	26	28
32	30	23	18	31	11

1024	$22^h\,00^m$				
S d	0.855				
26	23	26	14	22	23
34	21	13	21	13	8
18	26	21	18	11	12
31	46	35	25	28	25
40	44	50	44	52	50
26	22	35	40	30	26

1346	$22^h\,20^m$				
W g	0.826				
34	19	34	41	45	32
55	27	50	28	32	36
21	32	43	29	34	27
31	36	29	31	42	35
20	30	33	40	37	25
17	21	29	27	34	33

676	$22^h\,40^m$				
W b	0.630				
2	44	58	43	48	30
5	93	48	59	68	52
2	74	67	50	57	23
7	36	46	41	32	23
1	48	71	49	23	21
6	59	52	55	28	27

1358	$23^h\,00^m$				
W g	0.898				
31	38	19	36	56	27
31	38	18	25	31	51
57	31	44	40	18	40
53	41	38	36	27	24
49	42	58	51	36	43
56	92	54	46	35	28

1760	$23^h\,20^m$				
W i	0.807				
37	34	62	45	33	31
32	37	44	50	33	34
21	38	30	52	59	44
56	72	67	62	119	61
43	65	55	73	43	46
43	39	41	72	70	55

691	$23^h\,40^m$				
W b	0.592				
44	31	45	29	28	39
88	32	56	30	51	43
105	43	39	47	39	47
62	75	61	38	66	74
72	84	137	74	74	42
55	49	28	46	46	48

1780	$0^h\,00^m$				
W i	0.889				
28	45	45	60	49	25
29	40	30	27	61	50
49	38	48	27	29	59
34	29	27	13	31	45
30	31	51	51	42	37
35	30	45	56	32	38

δ = +15°

1280	$18^h\,00^m$				
S f	0.852				
2	9	6	9	6	15
6	18	5	4	9	25
8	7	11	9	11	17
13	7	8	14	13	27
15	4	10	13	17	10
6	9	8	9	14	3

1686	$18^h\,20^m$				
W i	1.037				
1	2	2	5	6	3
2	5	2	5	1	4
1	1	6	5	12	5
0	2	2	10	9	10
1	2	1	5	8	11
0	2	3	1	3	2

1689	$18^h\,40^m$				
W i	0.779				
3	0	3	1	8	2
0	3	0	2	3	6
2	2	0	0	1	1
1	0	0	1	1	1
0	0	1	1	0	2
3	1	2	0	0	1

879	$19^h\,00^m$				
W b	0.767				
0	0	0	0	1	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
1	0	0	1	0	0
0	0	0	0	0	0

857	$19^h\,20^m$				
S b	1.000				
1	1	0	0	0	0
0	0	1	0	0	0
1	0	1	0	0	0
0	0	1	0	0	0
0	0	0	0	0	0
0	1	0	0	0	1

1680	$19^h\,40^m$				
W i	0.779				
0	0	1	0	0	0
1	0	0	0	0	0
1	0	1	0	0	0
1	0	0	0	0	0
1	0	0	1	0	0
0	0	0	1	1	1

1665	$20^h\,00^m$				
S i	1.016				
1	2	0	0	0	1
1	0	1	0	0	0
1	2	0	0	1	0
1	2	0	1	0	0
3	1	2	3	0	0
2	1	2	0	1	1

1349	$20^h\,20^m$				
W g	0.839				
4	1	5	1	3	1
2	2	4	5	4	3
5	4	8	5	0	2
7	7	5	4	2	2
10	10	4	8	3	2
10	7	9	2	0	1

1687	$20^h\,40^m$				
S i	1.082				
7	10	1	1	6	2
13	19	5	3	6	3
7	5	4	3	1	5
4	5	2	4	7	8
8	8	10	5	10	6
4	8	15	14	10	7

956	$21^h\,00^m$				
S d	0.783				
2	35	18	26	18	11
8	15	14	19	25	21
2	40	36	35	20	14
2	39	37	21	18	14
3	37	33	37	32	15
8	28	56	33	25	13

941	$21^h\,20^m$				
S c	1.127				
23	31	36	18	24	16
17	13	23	18	15	23
20	25	18	17	23	17
23	21	15	21	16	23
25	15	15	31	23	28
16	28	33	21	32	29

943	$21^h\,40^m$				
S c	0.825				
23	22	16	26	19	11
26	20	16	21	32	11
47	43	21	24	25	25
36	27	35	41	29	20
33	38	44	38	36	23
32	36	39	41	38	16

963	$22^h\,00^m$				
W d	1.222				
24	23	14	18	12	9
57	34	49	14	19	17
30	31	24	19	22	38
46	34	67	31	26	25
60	31	20	23	10	26
25	19	23	13	7	19

1032	$22^h\,20^m$				
S d	0.960				
34	33	37	27	24	29
35	48	38	25	43	49
33	29	34	24	40	23
40	41	38	47	54	32
33	34	26	31	75	48
22	21	24	36	32	27

686	$22^h\,40^m$				
W b	0.763				
8	59	56	33	56	30
8	51	75	38	26	30
7	59	48	40	41	38
4	55	42	44	49	48
9	42	33	53	52	42
4	49	63	52	69	37

1335	$23^h\,00^m$				
W f	0.822				
43	39	73	53	32	37
42	59	40	37	39	38
70	38	53	64	49	45
69	31	50	53	50	40
62	32	33	60	39	27
39	41	23	35	54	32

693*	$23^h\,20^m$				
W b	0.609				
55	57	114	42	31	47
53	72	132	61	66	49
31	54	93	76	60	70
88	79	179	46	62	76
50	74	90	50	79	59
53	64	71	48	38	52

942	$23^h\,40^m$				
W c	0.995				
52	54	31	27	31	25
70	51	32	42	32	28
44	33	32	35	53	20
40	45	42	61	36	36
56	35	46	37	24	22
36	26	35	20	26	29

944	$0^h\,00^m$				
W c	0.866				
43	38	45	43	34	62
32	37	48	40	47	72
55	49	73	60	62	63
50	58	36	63	57	40
39	49	60	57	68	59
28	46	38	53	52	24

TABLE IV. (continued)

$\delta = +20°$

507	$18^h\ 00^m$				
Sa	0.748				
9	18	9	10	11	4
35	18	22	10	16	11
7	11	26	14	12	14
3	5	13	14	17	7
16	3	6	10	33	14
8	9	9	8	4	15

861	$18^h\ 20^m$				
Wb	1.095				
7	8	5	4	11	8
5	2	3	8	8	22
4	3	6	2	3	10
4	3	2	3	8	3
4	3	0	2	6	6
1	2	2	0	3	1

1263	$18^h\ 40^m$				
Wf	0.814				
2	1	3	5	9	7
0	0	2	4	5	0
0	0	0	3	9	2
0	2	3	1	8	2
0	3	2	2	4	0
1	2	1	1	6	2

1312	$19^h\ 00^m$				
Sf	1.062				
1	0	0	0	1	1
0	0	1	0	0	0
0	0	0	0	0	0
0	0	0	2	0	1
0	0	0	0	0	1
0	0	0	0	1	0

884	$19^h\ 20^m$				
Wb	0.767				
0	0	1	1	0	0
0	1	1	0	0	1
0	0	0	1	2	1
0	0	0	0	1	1
0	0	0	0	0	2
1	0	0	0	0	2

516	$19^h\ 40^m$				
Sa	0.957				
0	0	1	0	0	0
1	1	4	0	0	1
1	2	3	2	0	0
1	0	0	0	0	0
1	1	0	0	0	0
0	0	1	0	0	0

1685	$20^h\ 00^m$				
Wi	0.779				
0	0	0	1	0	0
0	0	0	2	0	0
0	0	0	0	0	0
1	0	0	1	0	0
0	1	0	0	0	0
0	0	0	0	0	1

1278	$20^h\ 20^m$				
Sf	1.062				
2	5	4	1	2	1
0	3	2	2	1	0
6	1	3	1	1	0
5	0	4	6	1	2
8	2	1	6	2	1
3	4	3	4	2	1

1754	$20^h\ 40^m$				
Wi	0.873				
19	29	17	9	3	4
23	14	18	9	2	2
14	9	4	17	5	5
7	6	9	18	6	3
10	7	5	6	2	7
5	11	2	4	4	2

948	$21^h\ 00^m$				
Sc	1.195				
14	7	11	9	18	17
12	13	19	17	20	20
9	12	10	8	10	4
9	9	7	8	9	5
13	25	16	15	15	11
17	27	17	19	15	8

953	$21^h\ 20^m$				
Sc	0.965				
24	30	15	43	19	15
24	15	18	13	14	18
34	14	19	21	19	22
19	17	14	15	20	11
12	31	15	25	19	9
21	19	41	23	24	19

976	$21^h\ 40^m$				
Sd	1.440				
43	56	23	27	18	15
34	39	27	19	24	20
42	27	25	17	18	16
12	16	12	16	7	9
20	18	16	8	16	4
13	16	12	12	12	12

1023***	$22^h\ 00^m$				
Sd	2.053				
14	6	9	11	8	18
8	12	6	7	12	8
8	22	10	10	10	11
14	4	16	7	8	6
18	20	14	14	6	3
15	22	13	9	10	2

1030	$22^h\ 20^m$				
Wd	0.960				
43	26	28	16	16	23
34	24	20	12	14	27
53	26	24	25	21	28
42	29	17	24	22	13
32	36	40	32	29	27
27	31	35	29	26	30

679	$22^h\ 40^m$				
Sb	0.774				
27	25	27	41	38	28
30	35	23	33	27	22
70	45	45	47	36	43
52	57	52	27	55	40
50	66	40	59	65	32
54	61	58	37	62	22

2009	$23^h\ 00^m$				
Wk	1.050				
38	28	36	28	25	15
22	29	21	33	33	30
26	17	40	35	34	30
16	17	82	36	46	35
26	37	27	62	29	27
24	25	64	41	23	13

957	$23^h\ 20^m$				
Wd	0.893				
55	41	27	38	33	18
46	37	31	37	18	25
41	36	66	30	29	15
45	65	63	74	31	16
30	35	62	78	83	22
38	33	96	42	31	26

968	$23^h\ 40^m$				
Wd	0.964				
14	19	40	22	66	58
26	19	29	32	69	45
19	16	19	53	94	27
32	21	35	35	41	35
46	34	41	24	50	25
46	55	30	29	30	27

701	$0^h\ 00^m$				
Sb	0.877				
20	10	29	23	16	9
30	37	37	39	29	32
54	36	34	50	38	40
54	49	52	60	47	51
54	33	38	34	32	49
42	27	55	46	32	50

is unsymmetrically placed with reference to the distribution of obscuring matter north and south of the galactic plane.

The quantity $A + B$ represents the log number of extragalactic nebulae per square degree reduced to the pole, with the corrected values in the last column of Table III in reasonable agreement for the two poles. The observed excess for the north as compared with the south pole is too small to be very significant. It is well known that for the brighter extragalactic nebulae the north polar cap is more densely populated than the south polar cap. According to Shapley (1957), however, the surface densities of nebulae between 19th and 20th magnitude at the two poles are about equal. Hubble's counts, which were extrapolated by him to magnitude 20, and which actually extended on the average only to approximate magnitude 18.9, indicate an excess of galaxies in the south polar cap of about 7 per cent. The evidence at hand gives no significant indication of any difference between the densities of the fainter nebulae in the two hemispheres.

One further point should be mentioned. In calculating the effect of atmospheric extinction on log N, we assumed that a difference of 1.0 in limiting magnitude corresponds to 0.60 in log N. Hubble likewise made this assumption, which neglects the effect of redshift. Hubble's empirical determination of the relation between limiting magnitude and log N yielded a coefficient of 0.50 instead of 0.60. With this smaller value we calculated corrections to B and $A + B$ in Table III. In no instance did the change in B or $A + B$ exceed 0.01. The effect of using 0.60 instead of 0.50, or some more probable intermediate value, may therefore be neglected in correcting for the effect of atmospheric extinction.

The mean galactic extinction at the two poles is found by dividing B by a factor that depends on the allowance for redshift as based on limiting magnitude. In the present instance the observed limiting magnitude of the plates for nebulae averaged 18.2, but reduction to the zenith decreased the average by about 0.1 mag., and reduction to the galactic poles by another 0.2 mag. In the average we should thus use a redshift corresponding to 17.9 mag., or a value of $d\lambda/\lambda = 0.077$. The corresponding quantity by which we divide B is 0.52. The limiting magnitude 17.9 is affected by redshift. If there were no redshift, a nebula of this apparent brightness would have

TABLE V. AREA I, UNCORRECTED COUNTS OF NEBULAE PER SQUARE DEGREE

δ = -20°

977	$0^h 00^m$	Wd	0.927		
13	26	27	33	26	23
26	24	40	23	42	40
40	20	26	17	43	23
27	37	21	36	42	33
18	30	28	40	32	25
26	22	26	25	29	25

1025	$0^h 20^m$	Sd	1.418		
15	18	18	29	13	14
32	16	28	16	16	10
27	18	32	35	37	50
24	22	46	19	23	31
25	27	46	29	12	9
21	25	27	36	10	14

1326	$0^h 40^m$	Wf	0.998		
31	47	41	31	30	11
39	36	83	44	25	20
68	85	55	47	44	35
44	58	48	39	39	25
50	74	47	58	48	35
42	44	79	85	37	32

659	$1^h 00^m$	Sb	1.052		
55	44	33	50	30	25
38	40	37	44	30	23
37	33	48	49	60	50
21	30	48	36	34	34
23	44	44	49	45	40
18	25	64	68	50	39

975	$1^h 20^m$	Wd	1.273		
28	27	33	58	36	39
17	28	43	34	30	25
24	44	28	29	11	31
13	30	32	32	19	19
28	33	21	38	17	23
15	30	23	33	21	20

1759	$1^h 40^m$	Si	1.026		
35	17	29	21	28	39
47	21	24	13	14	28
29	11	17	28	19	19
43	35	25	17	15	18
45	35	32	37	31	56
21	37	20	22	40	25

663	$2^h 00^m$	Sb	0.910		
27	29	40	29	34	30
53	46	29	26	25	41
30	36	26	20	20	34
24	22	23	40	34	48
17	27	14	42	34	37
28	44	30	25	27	29

1795	$2^h 20^m$	Sj	1.041		
43	54	60	32	23	27
25	19	31	37	29	38
23	55	32	17	24	17
57	37	30	20	20	21
29	39	31	43	37	15
14	49	14	15	10	25

1082	$2^h 40^m$	Se	0.663		
36	77	100	66	35	72
38	43	41	50	48	27
25	54	57	78	91	35
53	45	38	69	43	76
46	46	38	36	26	31
17	51	32	31	21	41

716	$3^h 00^m$	Sb	0.956		
56	43	48	34	33	48
48	39	40	28	24	30
41	21	25	23	21	18
46	35	18	24	33	39
51	59	13	26	41	39
51	32	41	43	28	18

660	$3^h 20^m$	Wb	0.971		
22	43	39	33	37	33
36	39	46	31	41	49
50	49	33	35	63	30
39	30	20	36	28	37
51	35	31	22	34	42
34	44	34	28	35	30

1040	$3^h 40^m$	Sd	1.321		
43	32	21	47	28	23
28	44	51	58	36	27
30	37	35	30	39	27
30	25	30	23	40	27
12	24	28	24	21	27
21	23	22	24	28	22

1800	$4^h 00^m$	Wj	0.599		
37	71	67	47	55	57
30	27	57	72	53	60
44	43	43	56	55	40
35	42	42	42	42	43
47	70	37	57	41	32
32	20	13	31	19	22

664	$4^h 20^m$	Sb	1.182		
15	48	21	21	21	26
38	49	23	31	22	17
26	23	19	15	25	9
39	26	16	11	16	13
27	12	12	18	8	20
17	22	8	23	20	16

1796	$4^h 40^m$	Wj	0.780		
59	60	47	29	28	29
83	78	47	31	27	45
88	60	32	22	39	31
175	199	59	37	78	42
73	73	80	49	54	28
28	25	72	64	47	25

2115	$5^h 00^m$	Sl	1.088		
14	23	33	32	51	41
35	74	44	85	76	54
54	56	67	63	78	27
22	44	84	65	110	97
20	23	53	66	64	40
13	23	22	91	33	10

671	$5^h 20^m$	Wb	0.858		
23	14	24	37	16	15
22	24	18	29	20	57
24	33	37	38	33	37
34	46	29	35	44	29
25	29	27	38	21	14
19	23	35	30	22	18

661	$5^h 40^m$	Wb	0.841		
20	25	5	12	19	16
18	9	16	17	25	20
22	26	33	18	10	18
32	16	29	33	32	24
20	23	18	11	17	19
23	29	15	16	24	5

1041	$6^h 00^m$	Wd	1.203		
6	12	15	16	11	10
11	24	26	25	27	13
27	17	19	16	26	20
19	23	17	24	28	25
16	27	17	30	35	14
10	16	19	7	16	14

δ = -15°

979	$0^h 00^m$	Wd	1.212		
24	23	25	23	13	19
25	14	35	18	16	40
16	15	20	32	18	30
18	28	34	39	37	41
34	27	37	45	42	25
24	30	30	40	28	27

1081	$0^h 20^m$	Se	0.690		
61	61	44	48	54	55
56	62	46	63	35	33
61	47	69	43	33	28
53	76	48	65	56	43
45	75	61	56	42	64
29	42	36	59	39	32

1750	$0^h 40^m$	Si	1.064		
45	39	48	61	53	34
78	47	52	26	42	32
47	57	64	65	53	48
42	43	26	27	26	27
30	48	23	38	26	26
34	59	41	39	30	12

2013	$1^h 00^m$	Wk	0.941		
30	52	80	83	64	27
76	83	66	69	82	70
107	61	27	84	66	32
88	227	54	86	41	48
102	114	55	75	76	33
58	50	46	55	37	19

2075	$1^h 20^m$	Sl	1.333		
41	52	40	34	21	24
48	60	55	57	56	49
56	33	21	52	55	64
56	39	42	43	48	74
32	41	33	33	62	40
29	36	31	58	34	44

1002	$1^h 40^m$	Wd	1.182		
28	33	31	31	57	45
22	40	19	27	45	29
32	45	33	43	77	68
34	67	48	28	52	71
34	36	32	31	16	31
34	18	17	27	25	40

1008	$2^h 00^m$	Sd	1.362		
14	17	41	19	16	26
19	60	60	28	13	16
33	53	47	18	27	28
40	29	33	46	39	29
25	30	48	34	23	33
15	19	25	23	20	15

2024	$2^h 20^m$	Wk	1.112		
39	30	38	46	36	6
32	60	25	33	27	18
35	58	17	39	28	38
36	55	31	39	32	42
25	57	78	33	37	32
45	41	42	25	16	14

2033	$2^h 40^m$	Sk	1.266		
12	21	32	22	18	35
24	13	24	27	31	30
30	27	20	21	30	38
20	29	31	31	17	22
27	28	20	26	19	20
25	31	46	33	20	45

737	$3^h 00^m$	Wb	1.042		
46	79	100	43	37	19
35	38	85	41	49	29
28	58	56	34	64	31
54	59	59	40	58	26
34	38	50	38	37	22
39	39	27	28	26	25

2094	$3^h 20^m$	Sl	1.071		
20	29	25	32	26	59
26	39	17	33	28	37
31	32	31	30	24	20
40	25	39	29	48	52
21	26	21	50	30	26
21	30	24	16	24	35

2076	$3^h 40^m$	Wl	0.897		
27	35	33	43	24	26
42	69	71	53	50	37
42	51	59	58	35	36
43	33	36	46	58	31
56	56	47	43	61	33
47	61	34	54	47	31

2056	$4^h 00^m$	Sl	1.358		
19	21	22	38	22	22
39	47	35	20	32	38
20	27	39	16	23	29
27	38	28	16	22	41
51	26	29	27	25	34
15	15	20	17	31	27

1009	$4^h 20^m$	Sd	1.256		
69	68	23	23	25	10
119	40	23	29	57	20
14	33	29	39	25	24
19	33	32	40	35	29
13	18	22	25	34	40
11	30	21	16	16	20

1844	$4^h 40^m$	Sj	1.090		
17	22	36	29	33	77
29	38	32	26	45	105
33	65	39	26	21	19
37	65	89	22	17	30
38	68	55	21	15	25
37	51	41	21	16	20

2296	$5^h 00^m$	Sm	0.932		
21	11	36	34	19	9
43	31	19	43	19	26
61	33	33	52	35	42
40	18	23	42	55	30
33	41	34	41	47	24
22	29	44	32	54	34

738	$5^h 20^m$	Sb	0.985		
14	16	32	33	29	15
23	28	24	32	25	35
23	31	20	39	35	32
11	24	20	42	32	19
9	24	14	35	40	22
19	10	24	27	17	12

1155	$5^h 40^m$	Se	1.120		
11	8	7	12	9	8
9	9	14	15	21	19
12	11	15	8	9	17
13	12	13	16	21	12
14	12	9	22	16	6
16	9	4	8	12	14

1124	$6^h 00^m$	Se	0.864		
2	2	6	4	4	9
5	9	9	9	5	13
7	8	11	8	7	12
11	3	6	13	8	21
11	18	16	14	20	8
20	11	19	19	11	17

TABLE V. (continued)

δ = -10°

1086 $0^h\,00^m$ We 0.823

59	36	57	76	49	53
42	40	47	49	64	39
26	26	39	50	85	23
52	44	57	47	78	92
60	38	57	51	56	78
35	43	38	35	27	40

964 $0^h\,20^m$ Sd 1.276

57	33	27	19	41	34
27	32	34	25	29	16
33	42	30	27	36	14
32	34	33	36	36	37
34	40	24	22	40	42
36	31	20	28	33	33

1470 $0^h\,40^m$ Sg 0.885

106	92	73	56	102	81
120	41	66	53	65	50
88	59	90	146	40	44
73	47	71	65	40	42
50	64	50	53	62	48
51	33	52	46	56	35

2059 $1^h\,00^m$ Sl 1.408

22	25	48	37	33	49
19	25	30	26	41	69
27	32	26	35	71	50
36	37	34	33	115	41
28	31	40	45	50	28
19	34	54	56	45	18

1765 $1^h\,20^m$ Wi 0.913

40	54	76	73	19	21
48	64	88	62	42	27
40	56	64	55	56	36
90	48	66	65	48	42
44	55	43	33	63	29
60	61	63	49	42	44

1779 $1^h\,40^m$ Sj 0.787

100	88	73	80	41	41
82	88	78	48	65	56
74	71	60	67	111	40
58	53	77	67	70	82
27	41	57	63	47	58
38	61	61	47	100	64

969 $2^h\,00^m$ Wd 1.215

47	62	36	80	107	59
18	30	39	44	43	49
27	34	30	27	52	35
24	48	31	38	34	22
24	44	34	38	18	11
16	29	47	26	18	29

2027 $2^h\,20^m$ Sl 1.242

7	17	19	20	36	36
18	33	52	47	28	14
34	35	30	34	31	25
36	38	25	24	35	23
45	33	43	30	28	19
40	19	31	25	26	9

2034 $2^h\,40^m$ Wl 1.134

25	12	20	33	25	5
28	41	59	40	22	17
31	40	64	34	41	33
14	39	35	33	31	37
40	34	42	36	32	33
18	21	35	32	21	28

2109 $3^h\,00^m$ Sl 1.151

23	20	17	18	16	32
34	31	25	23	17	24
25	37	48	26	27	30
29	45	53	52	52	32
33	49	57	50	38	34
36	62	67	23	23	11

2060 $3^h\,20^m$ Wl 1.230

32	14	12	21	20	21
10	8	13	26	21	23
32	22	24	14	11	18
30	33	27	32	33	37
21	16	36	20	18	37
15	20	17	32	23	30

1766 $3^h\,40^m$ Si 1.333

17	22	37	16	40	32
53	38	22	12	26	11
27	34	33	18	26	28
18	46	37	18	29	21
28	40	24	21	22	11
11	19	22	33	10	10

2079 $4^h\,00^m$ Sl 1.050

38	20	7	10	27	20
60	29	22	29	35	63
30	27	29	28	28	23
29	40	31	29	27	23
16	13	35	44	20	38
20	26	20	31	14	13

2087 $4^h\,20^m$ Sl 1.296

30	11	30	19	59	35
28	25	31	17	41	39
28	50	38	30	21	27
48	29	65	19	21	17
43	50	32	33	24	9
75	69	29	19	25	6

2058 $4^h\,40^m$ Wl 0.748

23	29	15	55	36	36
37	37	52	42	36	27
32	34	47	57	21	37
27	32	21	36	48	52
20	19	27	37	49	48
5	30	46	42	41	84

1820 $5^h\,00^m$ Sj 1.144

16	16	8	38	53	6
15	20	27	38	28	29
10	22	25	47	22	18
12	17	20	45	34	8
12	11	38	59	30	9
17	16	27	43	17	6

1142 $5^h\,20^m$ Se 0.917

10	12	16	12	17	13
13	19	25	14	8	15
14	16	30	20	10	13
11	15	19	21	14	6
9	7	12	32	17	8
11	12	31	32	27	14

2118 $5^h\,40^m$ Sl 1.369

3	4	0	0	0	6
1	0	0	0	2	11
1	0	0	0	1	5
3	1	0	1	7	5
2	1	1	7	5	5
7	6	3	6	3	3

1157 $6^h\,00^m$ Se 0.900

1	0	0	0	3	3
2	2	3	1	3	0
1	3	3	0	2	0
7	3	2	1	0	1
8	3	1	2	2	2
0	3	7	1	1	6

δ = -5°

1320 $0^h\,00^m$ Wf 1.130

29	41	36	39	43	27
40	44	38	48	54	49
28	28	26	44	34	30
43	26	21	36	25	36
61	32	33	22	44	18
44	27	33	53	38	31

1329 $0^h\,20^m$ Wf 1.006

94	57	69	54	55	31
77	60	62	58	65	45
49	32	46	46	26	21
53	49	29	19	32	37
60	39	28	39	40	45
46	35	27	25	34	42

715 $0^h\,40^m$ Sb 1.011

74	55	59	70	100	125
106	57	47	37	100	62
61	92	52	47	59	43
52	49	41	45	52	70
50	62	39	28	47	47
72	61	54	44	56	62

1740 $1^h\,00^m$ Si 1.149

32	45	84	80	69	59
33	53	61	122	110	90
33	33	75	43	46	55
31	30	49	51	36	37
47	40	57	32	65	28
18	24	46	35	42	47

998 $1^h\,20^m$ Sd 1.351

60	51	41	45	35	32
47	45	39	35	43	23
41	49	49	23	10	13
23	39	40	21	23	20
27	33	36	20	23	41
21	44	52	57	10	14

2016 $1^h\,40^m$ Wk 1.117

39	58	50	55	28	54
77	60	51	62	42	43
64	101	62	58	60	60
50	39	49	85	87	36
56	50	51	75	44	22
82	73	60	47	40	36

1342 $2^h\,00^m$ Sg 1.008

50	28	39	43	76	51
43	30	32	44	59	77
26	52	33	34	54	56
47	39	44	37	67	46
65	60	63	45	89	78
58	58	46	83	135	64

1827** $2^h\,20^m$ Wj 0.484

54	95	67	76	95	75
60	86	61	48	75	54
44	66	74	73	56	29
95	75	110	63	51	46
24	47	87	67	62	73
16	24	40	35	51	54

2035 $2^h\,40^m$ Sl 1.439

14	17	21	21	17	9
18	24	26	52	14	21
15	28	37	32	20	17
24	11	36	26	15	25
23	15	27	22	30	8
22	14	18	28	15	6

2128 $3^h\,00^m$ Sl 1.171

64	55	27	18	26	20
29	55	20	31	20	13
26	59	18	28	24	13
26	22	29	22	32	20
23	25	35	22	20	24
23	27	17	15	18	19

688 $3^h\,20^m$ Sb 0.856

43	80	56	55	50	86
55	96	54	32	34	32
72	56	46	40	28	31
49	40	35	32	15	32
41	27	40	31	21	25
49	15	17	21	27	14

999 $3^h\,40^m$ Wd 1.222

14	20	19	49	18	16
29	17	25	29	46	31
24	32	74	73	53	46
31	23	17	45	48	28
25	17	28	42	32	20
22	25	40	20	31	28

2083 $4^h\,00^m$ Sl 1.408

10	12	20	13	8	14
24	13	18	19	12	23
34	19	25	9	20	20
32	18	14	24	43	16
43	22	15	19	24	16
27	21	9	2	14	11

2283 $4^h\,20^m$ Wm 1.059

18	16	32	42	21	13
26	36	54	52	62	37
53	50	36	40	49	31
52	43	33	35	29	24
18	53	45	42	30	37
36	15	39	34	64	34

657 $4^h\,40^m$ Sb 1.260

19	36	30	46	56	14
34	34	35	40	29	14
38	18	22	12	27	39
28	41	21	11	26	48
27	26	25	8	20	14
5	8	4	30	16	26

1150* $5^h\,00^m$ Se 0.800

16	28	18	39	12	13
23	21	24	66	19	48
10	29	14	26	38	31
18	15	30	40	42	35
8	17	22	31	49	38
18	25	13	52	64	11

2110 $5^h\,20^m$ Sl 1.176

1	0	5	5	4	11
4	2	14	8	16	16
1	9	6	13	10	7
1	16	14	8	7	12
4	19	19	14	11	5
8	6	6	11	12	10

2120* $5^h\,40^m$ Wl 1.105

1	0	1	2	8	2
2	5	0	3	6	3
0	0	0	1	0	1
4	1	1	0	0	1
1	2	0	0	1	3
6	3	2	1	0	6

2111 $6^h\,00^m$ Sl 1.230

0	1	0	1	1	1
1	3	1	0	2	0
1	0	0	1	1	0
1	0	1	1	1	0
0	1	0	0	0	0
1	2	0	1	2	2

TABLE V. (continued)

δ = 0°

981 $0^h\,00^m$ Wd 1.967

24	25	16	23	22	22
28	21	32	20	30	22
40	30	54	38	36	22
42	42	23	22	23	13
31	42	20	20	63	14
18	34	38	30	33	26

1729 $0^h\,20^m$ Si 1.329

58	44	26	14	37	26
77	56	37	51	55	29
49	41	37	31	49	51
45	89	44	39	76	51
41	56	85	107	51	37
81	33	53	36	32	15

675 $0^h\,40^m$ Sb 0.987

42	47	50	71	75	77
48	70	63	48	90	86
77	75	85	81	43	70
59	49	75	67	55	56
59	76	90	62	52	51
70	49	60	70	108	111

1744 $1^h\,00^m$ Si 1.033

54	67	54	33	23	38
67	98	50	27	42	55
81	65	66	48	90	57
89	95	75	58	87	41
38	76	114	44	202	50
34	46	103	74	63	61

2073 $1^h\,20^m$ Wl 1.075

1	28	42	58	51	38
8	43	133	85	71	52
7	34	73	64	101	66
9	55	73	122	123	89
0	78	112	67	56	40
2	65	56	46	56	37

1761 $1^h\,40^m$ Si 1.097

33	40	45	45	42	27
62	41	32	56	50	27
65	53	37	41	38	59
51	55	44	49	84	39
56	39	39	45	37	47
44	58	43	56	28	53

655 $2^h\,00^m$ Wb 0.768

37	67	41	47	49	30
35	65	57	39	50	54
49	65	92	68	67	74
51	66	73	50	81	55
44	73	88	128	67	52
58	43	66	61	79	45

982 $2^h\,20^m$ Sd 1.852

17	8	4	12	8	9
40	13	4	13	17	22
33	16	13	10	8	11
19	20	12	7	13	11
25	31	25	6	12	14
6	31	21	15	19	23

2114 $2^h\,40^m$ Wl 0.862

26	31	38	39	35	40
37	35	48	62	95	53
37	46	52	43	35	55
40	80	71	24	53	47
53	48	32	41	45	42
27	34	44	35	30	17

2277 $3^h\,00^m$ Sm 1.288

2	23	33	31	33	22
3	27	30	28	29	19
7	41	50	36	31	36
5	45	39	19	28	30
9	44	46	30	29	33
0	49	21	18	24	19

678 $3^h\,20^m$ Wb 0.860

46	34	48	29	40	62
35	24	31	51	44	30
65	33	42	59	31	41
45	66	86	32	48	70
63	61	46	57	48	60
36	60	56	55	57	61

2074 $3^h\,40^m$ Sl 1.268

9	11	23	19	19	27
21	19	19	14	24	21
18	17	22	15	31	39
21	21	25	18	20	20
16	18	16	20	21	32
14	24	19	60	21	17

1762 $4^h\,00^m$ Si 1.248

24	13	2	3	6	4
19	19	8	10	14	12
10	11	6	12	11	11
11	30	12	12	10	14
14	37	20	8	4	12
20	18	27	17	14	16

2298 $4^h\,20^m$ Sm 0.772

22	22	25	44	43	42
39	30	18	28	49	29
43	37	26	30	45	10
39	38	46	40	49	24
23	44	32	35	45	15
28	22	43	63	27	23

1828 $4^h\,40^m$ Wj 0.804

8	19	18	11	13	12
0	28	32	22	15	40
9	57	39	60	37	38
1	37	35	33	38	29
0	37	28	40	32	17
6	40	52	53	60	25

1146 $5^h\,00^m$ Se 1.075

23	13	30	23	27	27
26	8	29	16	42	35
25	24	27	24	17	20
37	43	33	33	36	9
16	24	34	23	28	22
13	19	19	29	5	17

1509 $5^h\,20^m$ Sh 0.875

7	6	14	11	12	25
19	12	16	34	30	28
7	14	18	21	20	27
9	14	18	20	24	43
5	16	11	15	15	23
4	6	9	13	16	15

2095 $5^h\,40^m$ Sl 1.230

0	0	2	3	10	6
0	0	4	1	9	12
0	0	7	3	9	0
0	0	1	5	5	4
0	0	0	1	4	0
0	0	0	0	5	0

2305 $6^h\,00^m$ Wm 1.084

2	0	0	0	0	0
0	0	0	0	1	1
0	1	0	0	0	0
0	0	1	0	0	2
0	0	2	2	0	0
0	0	1	0	0	0

δ = +5°

1726 $0^h\,00^m$ Wi 0.882

21	31	46	68	33	45
42	62	57	55	38	71
54	58	74	79	74	74
56	77	92	49	41	34
58	79	72	73	71	59
49	56	48	42	42	51

1028 $0^h\,20^m$ Sd 1.171

43	38	42	47	34	20
43	46	50	74	83	31
66	41	44	41	46	33
69	33	36	48	53	46
42	49	31	46	20	42
56	48	32	18	39	23

1033 $0^h\,40^m$ Sd 1.059

33	51	36	41	38	52
16	35	38	101	66	43
43	31	48	37	59	48
32	28	45	43	45	62
39	28	36	71	67	49
38	45	48	63	51	60

677 $1^h\,00^m$ Wb 1.096

44	47	47	37	53	29
38	34	63	44	30	12
40	55	45	35	50	51
36	49	73	44	62	19
38	44	65	21	32	28
57	70	56	31	33	26

985 $1^h\,20^m$ Sd 1.292

7	20	48	37	27	29
17	34	45	44	35	20
16	30	23	44	34	23
52	52	30	56	37	23
32	24	34	46	58	33
32	29	38	47	39	33

2019 $1^h\,40^m$ Wk 1.001

41	29	46	54	38	29
44	29	59	68	48	61
45	26	40	60	52	38
34	32	23	29	59	50
27	46	38	45	40	40
36	38	58	49	35	31

2062 $2^h\,00^m$ Sl 1.290

37	29	39	35	28	22
27	28	20	41	37	40
21	42	15	30	51	32
39	42	45	28	28	32
32	34	32	38	42	18
19	36	30	28	30	17

978 $2^h\,20^m$ Wd 1.428

12	21	13	14	25	23
34	27	22	20	30	11
23	7	20	14	21	21
30	23	22	23	22	26
45	30	19	10	15	21
23	13	10	16	15	12

1029 $2^h\,40^m$ Sd 0.994

36	27	55	57	47	24
33	23	29	49	39	52
48	71	45	25	30	38
37	29	44	28	25	33
32	49	40	31	21	49
30	27	29	38	34	39

2104 $3^h\,00^m$ Wl 1.105

31	5	14	26	28	25
21	21	27	45	65	23
33	35	37	82	112	40
22	36	34	38	40	25
30	60	71	69	45	24
41	37	57	45	46	23

2136 $3^h\,20^m$ Sl 1.335

11	29	36	22	8	15
18	15	21	12	9	17
14	18	13	14	18	19
17	28	19	18	28	13
34	27	27	23	31	20
35	32	34	20	27	38

1818 $3^h\,40^m$ Wj 0.540

18	37	21	26	10	13
40	43	36	35	25	41
34	38	33	42	21	34
26	31	32	48	38	41
28	27	27	62	73	56
24	40	43	49	63	56

1822 $4^h\,00^m$ Sj 1.109

9	11	12	17	21	14
20	20	21	28	15	16
21	11	23	31	11	13
13	6	19	8	15	7
8	18	14	12	8	5
27	11	7	5	9	6

2063 $4^h\,20^m$ Wl 1.068

14	24	16	16	10	9
21	25	30	19	16	19
8	17	15	15	12	13
3	10	15	9	24	5
12	28	19	33	22	9
19	23	18	33	26	25

2102 $4^h\,40^m$ Sl 1.034

15	29	28	16	14	15
36	32	23	25	18	19
40	45	36	24	8	12
58	20	28	15	4	5
25	14	13	3	1	4
27	11	8	7	5	9

1042 $5^h\,00^m$ Wd 1.382

17	14	21	35	25	12
16	21	16	26	21	20
12	26	20	30	14	17
7	12	29	23	11	29
9	21	24	23	14	13
17	12	17	21	20	18

2129 $5^h\,20^m$ Sl 1.018

6	6	4	1	8	22
10	7	3	25	116	19
6	20	10	29	39	10
8	13	9	24	43	6
7	16	15	40	10	16
4	8	11	12	7	18

1517 $5^h\,40^m$ Wh 1.032

4	1	1	0	3	4
3	4	1	5	5	10
2	0	2	2	5	6
0	2	2	0	4	7
1	1	0	4	2	4
0	0	1	2	13	5

2137 $6^h\,00^m$ Sl 1.230

2	0	4	1	0	4
1	1	1	1	1	3
0	1	1	0	1	1
1	0	0	1	0	1
1	0	0	1	2	0
1	2	1	0	1	0

TABLE V. (continued)

δ = +10°

1780	$0^h 00^m$	Wi	1.130		
28	45	45	60	49	25
29	40	30	27	61	50
49	38	48	27	29	59
34	29	27	13	31	45
30	31	51	51	42	37
35	30	45	56	32	38

1809	$0^h 20^m$	Sj	1.077		
40	31	36	29	32	16
41	101	42	33	41	17
37	33	40	44	30	25
28	41	40	33	18	21
36	25	61	47	46	23
51	39	45	40	28	8

1332	$0^h 40^m$	Sf	1.136		
14	17	9	26	39	37
44	37	19	38	30	32
38	38	48	15	33	40
30	28	24	21	19	25
57	27	43	36	33	38
28	45	27	37	27	47

703	$1^h 00^m$	Sb	0.915		
51	77	29	74	54	13
56	31	40	41	42	46
58	55	39	22	49	39
99	45	46	33	31	31
46	60	42	41	52	58
52	48	76	58	58	27

1339	$1^h 20^m$	Wf	0.912		
31	46	32	63	63	34
44	64	64	77	51	57
17	54	66	60	40	48
25	44	78	45	49	55
25	44	124	48	37	43
29	36	60	52	52	41

2055	$1^h 40^m$	Sl	1.474		
30	59	27	22	39	24
16	31	29	15	29	14
19	38	44	16	17	16
22	24	18	20	8	12
42	31	31	18	11	16
20	20	34	54	27	12

692	$2^h 00^m$	Wb	0.678		
33	35	33	45	56	48
45	48	38	36	39	30
58	80	76	71	51	30
63	79	69	81	54	63
62	56	68	81	72	89
68	73	73	66	54	54

980	$2^h 20^m$	Sd	1.476		
14	28	19	6	16	13
23	17	19	17	14	20
26	17	31	20	27	17
57	36	22	26	23	20
22	20	24	17	11	35
23	24	21	16	27	32

706*	$2^h 40^m$	Wb	0.830		
70	60	51	34	35	34
71	51	38	47	60	30
50	41	59	74	79	52
45	43	42	40	77	103
36	42	29	51	31	36
37	34	44	64	51	31

1751	$3^h 00^m$	Si	0.895		
11	19	24	30	123	48
37	27	20	37	46	58
22	31	44	32	54	42
52	48	54	31	44	29
8	11	29	27	35	27
27	7	14	22	34	23

2280	$3^h 20^m$	Wm	0.890		
15	12	9	12	6	11
23	13	13	7	6	14
18	22	12	6	8	8
23	25	41	12	22	26
33	49	21	18	19	5
10	42	45	33	17	20

1772	$3^h 40^m$	Si	1.517		
7	7	12	10	6	7
16	17	7	10	5	7
16	16	10	24	18	10
8	16	8	30	26	8
8	17	11	11	14	11
9	18	8	13	8	3

1813	$4^h 00^m$	Sj	0.928		
3	4	7	9	17	10
2	4	10	14	6	14
2	8	7	13	19	16
7	12	9	18	14	12
9	15	17	15	9	8
8	17	13	15	21	13

1838	$4^h 20^m$	Sj	1.208		
3	3	8	1	3	1
6	6	6	0	2	2
5	11	5	3	10	0
7	2	8	8	14	7
14	9	8	7	10	6
11	18	16	9	9	8

766	$4^h 40^m$	Sb	0.926		
9	3	5	5	5	3
3	20	10	5	5	8
18	6	6	13	11	10
17	33	14	30	30	5
15	43	45	12	27	15
11	23	29	17	14	15

707	$5^h 00^m$	Sb	1.005		
2	2	1	7	9	6
3	7	14	7	2	3
6	14	10	13	9	16
15	20	19	28	19	7
10	16	31	24	13	10
27	18	29	35	20	9

2105	$5^h 20^m$	Wl	1.226		
0	0	0	0	4	1
0	3	0	0	0	0
0	1	2	2	0	6
1	2	3	5	5	7
3	9	3	4	8	6
4	4	2	1	12	21

689	$5^h 40^m$	Sb	1.000		
2	1	1	4	4	1
1	0	2	1	5	1
2	1	2	5	5	0
3	5	2	3	5	3
1	1	0	2	7	13
5	3	2	1	2	5

2329	$6^h 00^m$	Sm	1.064		
0	1	1	0	1	3
0	0	0	0	4	1
1	0	1	1	3	0
0	0	4	4	4	1
0	0	2	1	1	0
2	0	1	0	1	1

δ = +15°

944	$0^h 00^m$	Wc	1.101		
43	38	45	43	34	62
32	37	48	40	47	72
55	49	73	60	62	63
50	58	36	63	57	40
39	49	60	57	68	59
28	46	38	53	52	24

2032	$0^h 20^m$	Wk	1.304		
21	33	21	31	48	28
36	42	22	36	38	30
13	28	27	34	33	17
30	20	30	20	44	35
14	27	50	19	45	17
27	22	33	18	25	21

1737	$0^h 40^m$	Si	1.218		
28	29	34	26	24	31
30	39	34	46	28	25
59	53	42	37	24	26
27	21	42	35	30	27
19	13	19	40	28	18
17	20	11	22	38	32

687	$1^h 00^m$	Wb	0.792		
115	99	36	45	47	42
149	95	44	57	47	35
192	68	66	55	51	71
109	109	89	86	79	47
77	147	76	75	57	34
72	100	63	89	58	17

1336	$1^h 20^m$	Sf	1.190		
37	24	35	39	44	101
41	42	27	26	81	121
52	47	22	31	66	110
33	39	38	70	53	68
37	28	42	32	60	41
32	36	18	59	39	25

2091	$1^h 40^m$	Wl	1.187		
42	29	48	32	44	37
50	46	51	21	39	37
41	30	28	41	63	27
47	43	26	30	41	31
53	109	61	47	33	43
39	65	30	33	44	36

1077	$2^h 00^m$	Sc	1.114		
33	41	33	50	33	35
42	49	28	22	40	39
43	62	67	44	27	40
48	57	56	41	56	48
43	28	42	25	38	33
31	33	25	31	40	37

1791	$2^h 20^m$	Sj	0.876		
17	9	21	34	39	47
6	18	33	32	29	52
23	25	23	48	36	44
25	7	21	19	50	41
16	28	27	32	32	49
28	46	28	19	25	32

1026	$2^h 40^m$	Sd	1.461		
25	33	34	40	31	14
26	37	50	37	22	12
41	56	51	26	10	16
37	40	44	29	16	24
64	46	31	29	11	10
29	33	18	14	14	10

2358	$3^h 00^m$	Wm	1.154		
22	23	22	18	12	18
52	32	28	33	30	17
39	42	61	33	121	54
32	30	39	46	27	33
12	19	19	105	71	65
13	11	25	29	101	45

2352	$3^h 20^m$	Sm	1.123		
12	19	19	22	24	24
12	19	33	17	37	56
29	18	36	19	40	34
29	18	23	24	23	25
16	17	11	15	12	5
12	10	5	9	7	6

1769	$3^h 40^m$	Si	1.012		
11	16	8	11	9	10
16	23	15	20	11	12
16	11	16	74	32	23
15	9	6	30	14	18
21	30	6	21	10	9
13	10	16	12	9	14

1074	$4^h 00^m$	Sc	1.181		
4	3	6	3	6	12
10	3	5	6	15	10
7	10	9	11	11	14
0	6	12	12	13	12
14	8	29	16	9	12
9	6	6	6	15	6

1078	$4^h 20^m$	We	0.660		
10	11	10	11	6	6
15	12	10	9	11	9
6	6	8	5	7	10
13	10	20	8	12	9
19	19	23	15	23	22
10	13	19	9	8	9

1123	$4^h 40^m$	Se	1.056		
1	2	0	3	5	5
1	2	3	0	5	11
5	2	3	4	3	2
2	5	1	3	1	3
5	4	3	2	11	10
6	2	2	5	3	2

1811	$5^h 00^m$	Wj	1.095		
7	14	3	1	2	4
5	9	9	2	4	5
2	5	1	8	4	3
2	1	6	2	2	1
6	3	3	6	9	10
5	6	2	8	7	7

1841	$5^h 20^m$	Sj	0.733		
5	5	9	12	11	6
6	5	9	9	6	8
4	1	9	8	12	6
4	7	9	8	3	4
9	3	4	8	6	8
1	4	4	4	7	4

1154	$5^h 40^m$	We	0.813		
2	9	9	1	2	4
1	2	11	9	6	8
3	4	5	9	6	1
4	4	6	4	5	0
0	3	3	2	8	6
4	2	2	5	3	2

1819	$6^h 00^m$	Sj	0.944		
2	0	0	0	1	0
0	1	0	0	2	4
0	0	0	2	3	3
1	0	0	0	1	2
0	0	0	0	2	1
0	0	0	0	0	2

TABLE V. (continued)

$\delta = +20°$

701 $0^h\ 00^m$ Sb 1.163

20	10	29	23	16	9
30	37	37	39	29	32
54	36	34	50	38	40
54	49	52	60	47	51
54	33	38	34	32	49
42	27	55	46	32	50

1409 $0^h\ 20^m$ Sg 1.062

27	32	35	83	45	29
44	40	43	49	28	28
25	33	30	60	28	36
41	16	42	40	48	48
46	26	19	43	59	44
33	48	33	53	68	40

702 $0^h\ 40^m$ Sb 0.700

54	69	54	66	55	52
55	79	92	141	82	67
82	89	167	149	86	37
82	68	94	100	73	50
80	72	73	84	125	50
58	59	70	42	52	51

680 $1^h\ 00^m$ Sb 1.084

31	32	38	43	34	32
44	55	53	62	48	46
69	44	44	49	49	32
77	73	43	51	53	58
56	53	45	54	39	51
105	70	32	33	39	29

694 $1^h\ 20^m$ Sb 1.016

5	31	49	52	38	31
4	33	61	52	47	27
9	45	34	40	53	43
3	88	51	62	60	53
4	54	86	46	38	43
3	29	38	60	64	126

1110 $1^h\ 40^m$ Se 0.890

39	29	29	42	15	26
52	30	43	44	56	45
62	45	40	54	43	52
34	37	41	47	37	64
68	68	100	148	75	79
78	92	103	71	100	79

1471 $2^h\ 00^m$ Sg 1.005

23	27	13	17	36	36
30	55	70	47	28	40
45	39	55	76	31	48
52	82	48	39	33	30
58	72	68	107	51	39
47	42	37	43	39	38

1394 $2^h\ 20^m$ Sg 1.203

52	101	47	25	26	32
61	42	33	22	34	31
84	44	37	23	25	20
43	25	17	14	19	36
45	39	12	24	35	41
31	10	14	25	34	28

1410 $2^h\ 40^m$ Sg 0.890

12	21	11	21	29	51
8	35	20	27	26	34
12	24	26	13	32	77
29	39	30	25	45	38
31	63	35	41	39	50
34	50	47	49	48	23

647 $3^h\ 00^m$ Sb 1.137

6	21	28	9	9	4
8	17	10	3	3	5
9	34	15	5	1	16
7	68	10	10	0	13
9	50	35	31	9	28
5	37	32	23	12	18

681 $3^h\ 20^m$ Sb 0.879

10	8	13	16	11	20
10	19	11	23	8	8
16	12	4	20	16	28
14	16	19	20	19	59
21	31	25	15	21	39
18	30	29	33	34	35

710 $3^h\ 40^m$ Sb 0.926

27	29	15	22	37	3
27	22	11	4	6	15
15	22	13	16	16	12
17	9	14	7	12	10
6	14	14	7	7	9
15	19	12	18	10	10

1003 $4^h\ 00^m$ Sd 1.206

6	8	12	15	9	15
11	7	10	22	5	28
8	7	7	18	15	10
2	5	7	21	6	12
1	4	3	12	11	7
4	1	2	4	3	10

1472 $4^h\ 20^m$ Sg 1.155

0	2	5	8	3	8
7	4	4	1	2	1
8	2	4	0	2	6
7	2	1	1	0	1
10	3	4	6	3	3
13	5	5	2	5	4

1007 $4^h\ 40^m$ Sd 1.315

3	1	1	1	1	1
1	1	4	4	2	4
2	3	2	4	4	0
1	1	2	4	7	0
0	0	7	8	5	2
2	1	1	1	8	3

734 $5^h\ 00^m$ Sb 1.000

1	0	2	1	3	5
0	3	2	1	2	0
5	2	1	3	1	2
2	4	1	2	1	0
2	0	0	1	1	0
3	10	2	2	2	0

648 $5^h\ 20^m$ Sb 1.188

0	3	0	0	0	0
1	4	4	0	0	0
3	3	2	1	0	3
0	2	3	2	7	0
2	0	2	5	4	1
2	8	6	8	3	5

1516 $5^h\ 40^m$ Sh 1.047

0	1	1	0	0	0
0	0	0	0	0	1
0	0	0	1	2	0
0	0	1	1	0	3
3	2	5	3	0	0
1	8	6	2	1	0

1462 $6^h\ 00^m$ Sg 1.084

2	0	0	1	3	0
1	0	0	0	2	0
0	0	0	0	1	0
1	0	0	0	1	0
0	1	1	1	0	4
1	2	0	0	1	3

observed magnitude of 17.6. The data used re for the redshift-magnitude relation are taken om Humason, Mayall and Sandage (1956).

We select $B = -0.24$ as the most reliable lue of B, based on all six areas and derived om the full range of latitudes available in each ea. Thus we find for the galactic extinction efficient

$$\frac{0.24}{0.52} = 0.46 \text{ mag.}$$

his is considerably larger than Hubble's (1934) lue of 0.25 mag. For a more reliable compari- n we made a new solution based on the data of ubble's survey plates included in the six areas scussed in this paper. The result is $B = -0.19$, ith a corresponding extinction coefficient of 38 mag.

Oort (1938) recalculated the galactic extinc- on for Hubble's data between longitudes 0° and o° and obtained $B = -0.17$ mag. With a visor of 0.55, his value of the extinction at the les is 0.31 mag.

From his measures of the surface brightness d colors of extragalactic nebulae, Holmberg 957) found an extinction at the poles of 0.26 mag., and a color excess of 0.062. These results may be too small, however, because the low-latitude objects bright enough to be included in his program tend to be found in regions of less than average extinction.

Holmberg also determined the reduction in brightness due to internal absorption when the nebulae are viewed normal to the fundamental plane. He found that this diminution amounts to 0.28 mag. for Sc nebulae and to 0.43 mag. for Sa and Sb nebulae combined. Since our galaxy is generally considered to be of type Sb, it is of interest to investigate the relation between galactic extinction and the quantity 0.43 mag.

Let us call Δm_1 the extinction in magnitudes of an external object viewed from and normal to the central plane of a nebula.

Let Δm_2 be the reduction in magnitude of a nebula due to internal absorption when it is seen normal to its plane from an external point.

We distinguish three cases, two extreme and one intermediate:

(1) If the absorbing material is in two equal layers parallel to the fundamental plane of the nebula but outside the region of emission, then $\Delta m_1 = \Delta m_2$.

TABLE VI. AREA II, UNCORRECTED COUNTS OF NEBULAE PER SQUARE DEGREE

δ = -20°

1041	Wd	$6^h 00^m$	0.953		
6	12	15	16	11	10
11	24	26	25	27	13
27	17	19	16	26	20
19	23	17	24	28	25
16	27	17	30	35	14
10	16	19	7	16	14

1160	Se	$6^h 20^m$	1.090		
3	4	4	1	6	7
0	3	2	9	5	10
4	7	5	3	8	15
5	4	7	23	12	10
7	13	14	6	19	16
5	8	18	21	15	6

713	Sb	$6^h 40^m$	0.940		
0	1	1	0	1	2
0	0	1	3	0	5
1	4	0	3	2	3
6	0	0	1	6	3
1	2	1	4	3	3
0	0	2	4	2	6

1050	Sd	$7^h 00^m$	1.172		
0	0	0	0	0	1
0	0	0	0	0	0
0	1	0	2	1	2
0	0	0	3	3	3
0	0	0	1	1	2
0	0	1	0	1	0

1151	We	$7^h 20^m$	0.789		
0	0	0	0	0	0
0	0	1	2	1	0
0	0	0	1	0	0
0	1	0	1	0	1
0	0	0	0	1	0
0	0	1	1	2	1

739	Sb	$7^h 40^m$	0.940		
0	0	2	0	0	0
0	1	0	0	0	1
0	0	1	0	0	0
1	0	1	0	0	0
1	0	0	1	0	0
0	0	1	0	0	2

1449	Sg	$8^h 00^m$	1.022		
5	4	1	0	2	1
6	17	5	2	1	0
2	4	4	3	1	0
10	7	1	4	1	0
3	3	2	0	0	1
1	6	10	1	0	1

1125	Se	$8^h 20^m$	0.866		
7	11	9	3	6	3
22	5	11	5	9	7
14	13	4	8	3	2
11	10	14	10	9	12
17	14	11	10	10	2
9	5	7	10	6	3

1522	Wh	$8^h 40^m$	1.012		
8	1	14	4	2	5
0	6	7	7	12	17
5	20	9	11	13	8
8	12	14	20	13	9
7	8	7	8	5	7
8	1	5	1	4	8

714	Sb	$9^h 00^m$	0.898		
11	9	9	8	2	12
14	15	18	10	11	3
10	6	18	9	7	7
15	7	11	3	9	8
7	4	5	5	0	7
2	10	5	8	2	5

1846	Sj	$9^h 20^m$	0.983		
19	13	23	15	18	12
16	13	14	11	24	5
12	19	14	11	13	10
16	17	15	17	8	5
19	13	20	9	4	4
7	15	10	8	5	2

787	Sb	$9^h 40^m$	0.984		
12	21	25	21	20	14
23	30	19	30	13	15
10	13	23	39	24	8
8	14	21	50	46	12
9	18	20	15	31	20
8	10	20	17	12	8

740	Sb	$10^h 00^m$	0.963		
18	9	11	24	8	6
26	20	21	41	29	22
27	20	27	51	18	13
20	27	18	27	22	12
15	12	31	28	24	16
11	16	16	17	21	2

811	Sb	$10^h 20^m$	0.936		
15	16	26	33	43	17
24	32	30	29	25	34
16	21	48	32	29	31
24	25	19	7	28	15
13	20	15	28	25	13
10	9	11	6	9	14

773	Sb	$10^h 40^m$	0.966		
25	36	49	29	26	16
22	33	45	29	34	18
48	28	47	28	16	18
22	35	37	33	38	21
19	27	24	18	23	19
18	20	24	23	12	15

1523	Sh	$11^h 00^m$	0.652		
33	39	34	35	49	22
31	22	21	61	38	36
41	30	29	20	34	33
36	45	29	34	38	27
41	25	69	23	27	16
22	21	22	25	14	16

1180	Se	$11^h 20^m$	1.119		
16	11	8	15	29	16
13	13	11	16	16	10
15	16	23	14	15	17
13	18	8	14	35	10
15	17	12	14	24	27
11	21	18	14	18	10

1586	Sh	$11^h 40^m$	0.869		
17	40	39	51	33	15
36	38	31	17	38	17
30	28	14	31	20	18
41	46	16	30	28	21
29	47	26	21	21	24
9	9	17	15	20	10

788	Sb	$12^h 00^m$	0.894		
35	36	38	27	22	36
68	69	37	49	73	40
51	44	34	49	51	36
31	39	54	67	41	62
21	34	36	53	30	15
29	13	23	28	14	10

δ = -15°

1124	Se	$6^h 00^m$	0.742		
2	2	6	4	4	9
5	9	9	9	5	13
7	8	11	8	7	12
11	3	6	13	8	21
11	18	16	14	20	8
20	11	19	19	11	17

1521	Sh	$6^h 20^m$	1.149		
0	4	1	2	6	3
2	2	2	6	6	4
3	0	4	5	2	9
0	3	6	6	4	4
2	6	8	5	3	6
2	6	2	2	10	3

778	Sb	$6^h 40^m$	0.940		
0	0	1	1	0	0
0	0	1	1	1	5
0	0	0	0	3	1
0	1	0	1	1	0
0	3	0	1	3	4
1	2	1	0	1	2

1845	Wj	$7^h 00^m$	0.766		
1	0	0	0	0	0
0	0	0	0	0	1
0	0	1	1	1	0
1	0	0	0	1	0
0	1	0	1	1	1
0	0	0	1	0	0

2375	Sm	$7^h 20^m$	0.979		
0	0	1	0	0	0
0	0	1	0	1	0
0	0	0	0	0	0
3	1	2	1	0	2
2	1	1	1	0	1
0	0	2	1	1	0

2500	Wn	$7^h 40^m$	1.120		
0	0	0	1	0	0
0	5	1	0	0	1
1	7	0	2	0	0
2	3	0	2	2	0
0	1	0	0	0	1
0	0	1	1	0	0

1156	Se	$8^h 00^m$	1.262		
5	4	3	6	1	0
2	13	3	1	2	1
4	2	2	6	2	2
8	6	1	2	0	1
6	4	3	2	0	0
2	4	2	1	0	1

1158	Se	$8^h 20^m$	0.865		
10	11	12	15	5	11
20	18	16	21	9	4
7	23	25	18	9	4
8	11	16	9	11	8
3	10	3	3	9	7
9	11	13	4	5	2

1863	Sj	$8^h 40^m$	0.758		
10	13	18	9	11	11
11	13	17	16	24	15
26	25	16	25	19	10
13	10	26	14	17	7
13	9	14	14	11	6
10	9	15	3	2	5

1179	Se	$9^h 00^m$	1.054		
16	11	27	17	13	12
6	20	12	13	13	7
25	20	14	19	9	18
31	19	21	24	13	10
24	13	17	18	15	9
15	10	13	11	3	9

1877	Sj	$9^h 20^m$	0.904		
25	34	21	41	33	24
15	17	25	16	10	14
31	23	14	5	15	26
33	22	16	8	34	31
26	27	10	18	19	19
11	12	18	17	26	13

1883	Wj	$9^h 40^m$	0.704		
50	46	44	34	34	33
39	63	30	36	25	16
55	50	43	38	33	32
67	41	31	26	29	24
29	42	38	22	34	29
14	35	29	28	29	18

801	Sb	$10^h 00^m$	1.021		
20	39	24	22	29	45
12	25	20	20	49	26
30	46	33	43	39	35
30	43	62	41	58	60
43	32	19	16	30	14
21	9	11	22	8	10

1557	Sh	$10^h 20^m$	0.685		
46	32	24	49	38	34
42	23	34	41	27	35
32	39	41	35	16	44
43	31	53	43	29	36
37	30	41	23	38	46
28	23	37	37	55	24

1488	Sg	$10^h 40^m$	0.714		
45	54	68	33	41	44
50	55	49	50	44	29
55	55	48	56	44	33
45	47	56	39	30	31
53	80	54	53	31	28
40	45	65	38	30	22

2366	Wn	$11^h 00^m$	1.454		
19	30	14	28	22	20
28	27	25	34	24	19
30	47	47	30	24	25
22	28	58	27	20	14
20	12	28	37	24	29
20	24	20	15	31	7

2563	So	$11^h 20^m$	1.245		
40	33	23	32	33	19
70	33	40	18	19	31
50	38	34	41	21	36
27	22	10	10	19	17
15	22	14	10	6	7
9	5	7	10	14	7

1878	Sj	$11^h 40^m$	1.140		
43	27	49	68	41	34
28	19	39	46	94	47
45	33	39	41	25	48
58	58	41	17	44	29
36	48	49	47	26	25
19	43	38	42	27	12

1532	Sh	$12^h 00^m$	0.821		
45	39	49	42	54	52
63	66	54	44	45	39
49	45	41	37	77	57
49	39	29	23	49	76
51	52	29	38	48	65
47	36	50	39	28	32

TABLE VI. (continued)

δ = -10°

1157 $6^h\ 00^m$ S[illegible] 0.[illegible]44

1	0	0	0	3	3
2	2	3	1	3	0
1	3	3	0	2	0
7	3	2	1	0	1
8	3	1	2	2	2
0	3	7	1	1	6

2080 $6^h\ 20^m$ Sl 1.127

2	1	0	0	1	1
0	0	0	3	1	0
0	0	0	0	0	4
0	0	1	2	0	7
0	0	1	1	1	4
2	1	0	2	6	1

2364 $6^h\ 40^m$ Sm 0.979

0	2	0	1	0	1
1	1	2	1	1	0
0	0	1	1	0	0
0	0	1	0	1	1
0	0	0	2	1	1
0	0	2	0	0	1

2103 $7^h\ 00^m$ Sl 1.127

0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	1	1
0	0	0	0	0	3
1	0	0	0	1	0
0	0	0	0	0	0

1147 $7^h\ 20^m$ We 0.789

2	2	0	1	1	2
1	1	1	0	0	3
1	0	2	1	0	1
1	0	0	0	0	1
1	0	0	0	1	2
0	0	0	0	0	0

1134 $7^h\ 40^m$ Se 0.944

3	3	3	8	1	1
5	6	3	1	2	0
2	1	0	3	0	0
1	1	3	0	1	1
2	1	3	1	0	1
0	0	2	1	0	1

1852 $8^h\ 00^m$ Wj 0.844

25	8	9	11	7	3
2	8	12	15	13	7
5	0	30	11	3	2
25	17	13	9	5	0
13	7	11	5	5	2
10	6	9	2	2	1

1461 $8^h\ 20^m$ Sg 0.966

6	11	22	6	17	12
19	29	26	22	14	2
14	20	21	20	14	3
24	15	15	23	11	12
12	7	17	14	7	14
11	15	13	18	6	7

1872 $8^h\ 40^m$ Sj 1.032

16	17	16	22	13	8
12	20	19	31	14	14
14	23	43	29	23	9
20	13	28	20	29	15
17	14	26	12	16	13
11	13	13	5	12	10

1467 $9^h\ 00^m$ Sg 0.779

28	20	26	15	33	23
35	33	45	22	35	19
56	159	51	29	32	17
52	36	33	32	19	20
29	20	20	21	17	16
29	19	50	21	16	17

2398 $9^h\ 20^m$ Wn 1.062

16	25	22	32	39	23
14	16	27	43	40	27
21	19	27	40	26	30
16	12	25	22	34	19
20	15	20	23	25	15
20	29	35	30	30	15

1884 $9^h\ 40^m$ Sj 1.203

14	16	8	22	9	14
13	19	14	21	30	21
19	22	23	26	30	21
20	41	18	25	29	11
20	40	22	29	27	26
26	39	41	25	26	19

2501 $10^h\ 00^m$ Wn 0.883

49	31	34	49	22	23
29	31	30	41	20	25
61	43	51	20	42	21
15	18	22	25	25	19
24	38	38	22	22	27
18	36	31	25	35	34

1569 $10^h\ 20^m$ Sh 1.289

29	32	30	72	40	42
23	32	29	37	45	25
28	37	33	36	59	57
34	28	26	25	81	15
31	30	29	36	22	18
27	14	15	22	19	15

452 $10^h\ 40^m$ Wa 0.579

78	37	67	51	38	35
115	102	120	134	53	55
84	132	65	68	86	60
107	60	71	89	44	63
49	50	59	75	72	43
40	53	73	35	42	62

1210 $11^h\ 00^m$ Se 0.967

60	39	30	35	53	52
29	24	39	26	41	45
19	37	42	44	33	38
33	39	21	33	43	46
24	31	33	62	28	21
28	40	23	36	42	26

2844 $11^h\ 20^m$ So 1.428

35	29	45	32	32	27
39	33	28	18	17	16
64	37	27	23	14	20
50	41	29	38	27	20
41	34	20	20	19	19
23	31	23	28	21	14

2551 $11^h\ 40^m$ So 1.226

29	24	41	30	32	35
23	22	29	55	51	60
19	37	41	55	72	57
34	44	35	79	63	43
30	57	77	82	54	46
40	39	58	53	35	31

1529 $12^h\ 00^m$ Sh 0.699

63	89	79	44	60	47
63	59	34	41	49	44
31	32	36	52	58	35
44	37	22	35	41	52
53	37	29	34	51	40
44	40	52	51	57	39

δ = -5°

2111 $6^h\ 00^m$ Sl 1.127

0	1	0	1	1	1
1	3	1	0	2	0
1	0	0	1	1	0
1	0	1	1	1	0
0	1	0	0	0	0
1	2	0	1	2	2

2084 $6^h\ 20^m$ Sl 1.127

0	0	0	0	0	0
0	0	2	0	0	0
0	1	0	1	1	1
0	0	0	3	0	1
0	0	2	0	0	0
1	0	0	0	0	0

2141 $6^h\ 40^m$ Sl 1.127

0	0	0	1	0	0
0	0	0	0	0	1
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	1	0	0	2	1

2112 $7^h\ 00^m$ Wl 0.942

1	1	0	0	0	0
3	1	0	3	0	0
0	0	0	0	2	0
0	0	0	0	0	0
0	0	0	0	0	1
0	0	0	0	0	1

786 $7^h\ 20^m$ Sb 0.940

3	1	2	2	1	0
1	2	[illegible]	0	0	1
1	3	3	0	1	0
1	3	0	1	0	0
2	1	2	1	0	0
0	2	1	2	0	0

1143 $7^h\ 40^m$ Se 1.329

6	8	11	3	3	1
17	12	4	4	4	1
14	2	1	1	0	1
5	4	1	0	0	1
7	4	1	1	1	1
2	2	1	2	1	0

2119 $8^h\ 00^m$ Sl 1.012

5	14	16	12	14	10
10	10	18	16	20	17
11	9	8	19	27	20
8	8	13	25	16	6
8	21	12	12	10	6
9	13	9	6	4	5

1487 $8^h\ 20^m$ Wg 0.659

27	41	32	33	27	11
49	22	23	38	12	11
45	14	28	23	17	10
46	27	33	37	26	8
20	17	26	17	22	16
13	23	25	10	19	19

2143 $8^h\ 40^m$ Sl 1.584

9	7	6	17	18	16
9	8	12	9	20	25
23	26	7	11	8	25
10	12	8	19	38	20
18	9	11	10	14	6
13	9	5	16	9	6

1833 $9^h\ 00^m$ Sj 0.631

30	31	37	27	35	23
25	36	26	36	34	20
30	20	31	58	44	37
28	34	35	54	64	30
21	27	31	41	22	39
29	27	25	21	31	33

1201 $9^h\ [illegible]0^m$ Se 1.297

39	21	25	21	22	16
23	16	12	32	25	9
28	21	8	30	24	14
29	13	16	18	19	12
22	26	27	22	19	9
16	26	18	24	34	11

1148 $9^h\ 40^m$ We 0.583

42	54	64	40	63	59
43	60	62	70	65	37
69	76	91	83	99	44
59	54	52	62	56	42
60	41	52	40	40	34
42	34	31	35	20	23

435 $10^h\ 00^m$ Sa 1.106

59	41	35	66	39	27
55	40	42	56	45	31
27	54	62	44	40	42
44	126	58	34	33	29
27	61	57	39	47	27
44	35	36	40	20	14

438 $10^h\ 20^m$ Wa 0.764

52	73	82	90	70	54
41	72	64	81	71	57
38	49	75	155	55	32
44	31	63	102	74	57
33	48	27	127	29	21
34	38	42	81	41	60

443 $10^h\ 40^m$ Sa 1.221

23	41	37	34	24	45
37	62	35	52	37	40
34	52	34	14	15	18
47	36	17	24	20	21
35	17	20	11	36	14
35	13	30	19	17	13

2144 $11^h\ 00^m$ Wl 1.130

35	52	33	33	32	21
36	43	50	32	25	26
44	59	47	38	38	24
44	64	49	40	55	37
76	52	72	89	59	39
39	35	30	41	49	38

1834 $11^h\ 20^m$ Sj 0.831

43	28	34	61	34	59
99	46	61	57	70	58
95	78	66	73	67	54
77	92	43	87	80	49
48	56	31	34	49	61
58	40	56	37	37	30

1202 $11^h\ 40^m$ We 0.738

120	90	90	85	74	48
99	114	105	104	80	94
69	65	57	60	68	87
72	73	79	47	51	68
43	79	37	45	38	42
45	45	57	51	64	53

451 $12^h\ 00^m$ Wa 1.404

32	23	35	27	30	55
33	29	28	32	26	40
31	49	46	26	19	50
94	39	39	27	41	53
55	34	55	48	32	36
25	34	34	14	20	25

TABLE VI. (continued)

δ = 0°

2305 $6^h\,00^m$ Wm 0.818

2	0	0	0	0	0
0	0	0	0	1	1
0	1	0	0	0	0
0	0	1	0	0	2
0	0	2	2	0	0
0	0	1	0	0	0

2093 $6^h\,20^m$ Sl 1.127

1	1	0	0	0	0
0	1	0	0	0	0
0	0	0	2	3	0
0	0	0	1	2	1
0	0	1	0	4	0
0	0	0	0	1	0

2138 $6^h\,40^m$ Sl 1.127

0	1	0	1	1	0
0	1	0	1	1	0
0	0	1	0	0	1
0	0	0	0	0	0
0	1	2	1	0	0
0	0	0	0	0	0

2335 $7^h\,00^m$ Sm 0.979

1	2	2	0	1	0
0	2	2	1	0	0
2	2	0	0	0	0
0	0	0	0	0	0
0	1	2	0	0	0
0	0	0	0	0	0

1084 $7^h\,20^m$ We 0.789

2	3	9	4	3	0
4	7	3	3	2	1
7	4	5	3	5	2
7	4	9	8	2	0
5	4	3	6	1	0
6	2	2	1	2	0

1510 $7^h\,40^m$ Sh 0.804

12	3	10	9	9	0
13	8	4	10	7	5
16	10	18	10	8	10
9	11	16	16	1	6
7	11	5	7	5	4
15	7	13	8	5	3

1127 $8^h\,00^m$ Se 1.048

20	13	9	15	10	7
4	14	12	8	8	9
14	11	15	6	14	9
7	19	23	13	9	6
18	14	29	12	11	3
8	10	16	14	19	8

2149 $8^h\,20^m$ Sl 1.[illegible]04

7	23	21	8	8	11
8	15	18	15	15	3
29	32	21	13	20	7
27	22	27	20	21	6
16	28	14	13	11	10
18	18	19	14	16	4

1177 $8^h\,40^m$ We 0.569

30	52	57	43	21	15
42	74	51	65	40	40
64	49	36	56	41	46
15	20	32	31	29	37
30	33	31	33	62	20
25	25	24	36	33	30

2843 $9^h\,00^m$ So 1.573

20	23	15	21	7	7
12	23	20	27	20	15
17	27	9	17	24	18
9	16	14	11	21	7
31	27	16	17	15	11
17	14	13	11	18	14

1196 $9^h\,20^m$ We 0.734

35	58	64	48	15	25
37	51	45	58	33	24
57	54	43	37	23	33
35	48	45	53	31	21
40	51	36	47	62	41
48	36	40	36	28	18

784 $9^h\,40^m$ Sb 0.901

55	54	44	66	39	36
73	36	32	22	36	28
66	43	40	39	22	48
44	28	39	24	12	23
24	35	41	24	44	23
33	43	41	28	28	37

2557 $10^h\,00^m$ Wo 1.086

14	27	43	37	31	38
31	43	44	62	71	58
65	85	54	113	83	33
115	74	54	56	56	39
49	60	60	38	61	23
52	44	29	63	25	18

440 $10^h\,20^m$ Sa 1.216

28	35	27	45	29	8
21	36	42	45	25	17
30	30	38	38	62	54
34	27	24	51	47	97
41	34	35	47	77	59
32	57	38	74	45	45

446 $10^h\,40^m$ Sa 0.938

45	43	52	67	53	29
35	58	82	89	51	34
43	83	60	49	37	39
41	50	51	49	34	44
30	37	49	35	26	48
26	51	42	37	32	47

1514 $11^h\,00^m$ Sh 0.714

85	69	45	31	35	45
107	65	63	63	73	33
101	87	43	38	52	49
85	75	57	48	40	61
50	60	58	42	42	36
87	76	49	56	41	30

1874 $11^h\,20^m$ Wj 1.000

61	74	67	55	67	80
76	72	89	70	43	60
43	62	76	72	51	61
44	66	56	54	56	62
60	65	47	50	51	21
45	37	40	46	24	39

1197 $11^h\,40^m$ Se 1.002

31	55	47	44	23	43
34	27	24	44	53	81
49	42	36	32	40	33
46	74	52	60	44	24
44	89	133	36	44	43
78	76	71	55	58	22

792 $12^h\,00^m$ Sb 0.658

71	82	137	113	84	55
61	72	101	59	78	52
71	84	89	102	85	74
99	78	73	119	120	76
54	66	77	81	88	90
56	49	66	58	59	55

δ = +5°

2137 $6^h\,00^m$ Sl 1.127

2	0	4	1	0	4
1	1	1	1	1	3
0	1	1	0	1	1
1	0	0	1	0	1
1	0	0	1	2	0
1	2	1	0	1	0

2099 $6^h\,20^m$ Sl 1.127

0	0	0	0	1	0
0	0	0	0	0	1
0	0	1	0	0	0
0	0	0	1	1	1
0	0	0	2	2	0
0	0	0	0	0	1

1839 $6^h\,40^m$ Sj 0.916

0	0	0	0	0	1
0	0	0	0	1	0
1	0	0	0	1	0
0	1	0	0	0	3
2	1	1	0	0	0
0	0	1	0	0	0

2380 $7^h\,00^m$ Wm 0.876

11	1	3	1	0	0
12	5	0	5	2	0
8	3	0	1	1	1
4	1	1	1	1	0
1	3	1	0	0	0
1	4	3	2	0	0

181[illegible] $7^h\,20^m$ Sj 1.198

4	4	6	6	3	8
7	11	4	11	7	14
7	14	6	6	8	5
6	5	5	6	4	1
4	6	5	5	6	1
1	2	7	4	2	0

1503 $7^h\,40^m$ Sh 0.855

22	11	23	21	5	6
21	34	24	20	5	7
20	32	16	19	18	13
24	26	16	16	14	8
18	8	12	9	7	5
21	7	10	7	6	4

2121 $8^h\,00^m$ Wl 0.948

25	49	35	38	14	19
38	34	41	37	27	24
33	63	43	32	13	27
32	28	27	22	32	20
29	17	20	33	20	14
24	19	8	8	14	16

1485 $8^h\,20^m$ Wg 0.537

24	31	67	58	34	29
20	25	54	52	25	38
25	39	49	58	57	48
48	44	142	91	56	43
33	36	58	48	47	27
25	63	62	50	33	35

768 $8^h\,40^m$ Sb 1.259

18	11	9	11	18	12
17	11	16	12	8	9
27	23	21	21	18	14
32	30	29	18	35	25
14	29	32	26	15	9
12	29	33	28	15	8

1549 $9^h\,00^m$ Wh 0.688

49	54	32	32	41	25
40	36	33	37	45	35
32	38	44	37	34	39
43	57	33	24	46	39
59	49	57	61	47	18
30	37	25	31	26	19

1495 $9^h\,20^m$ Sh 1.015

30	43	46	55	61	33
25	19	27	58	38	24
22	26	28	30	26	16
26	42	41	43	21	25
32	32	32	16	24	30
25	31	37	42	9	21

1199 $9^h\,40^m$ We 0.857

57	53	40	26	42	33
72	84	87	40	52	29
58	47	53	47	37	27
51	49	51	44	45	38
47	31	67	61	64	48
51	51	35	54	35	15

1496 $10^h\,00^m$ Sh 0.821

41	61	87	46	51	58
81	58	62	46	38	51
42	40	37	60	48	39
28	15	39	52	34	33
45	33	61	80	60	36
15	45	42	32	41	33

1853 $10^h\,20^m$ Wj 0.763

67	40	64	69	53	47
39	54	62	70	80	44
62	59	71	35	51	38
100	136	64	49	65	24
76	110	54	67	60	41
41	59	54	80	32	14

1126 $10^h\,40^m$ Se 0.864

51	53	32	43	28	54
43	41	29	39	57	32
55	66	35	115	61	51
71	35	49	72	70	94
39	59	45	53	52	55
56	39	53	75	52	30

813 $11^h\,00^m$ Sb 1.195

44	36	70	56	42	22
32	54	44	63	49	28
43	55	52	31	40	30
59	37	42	46	21	42
47	63	48	34	18	36
81	63	41	33	28	33

1565 $11^h\,20^m$ Sh 0.682

42	52	62	39	43	55
75	40	39	50	35	55
72	39	30	40	51	60
55	60	30	59	67	77
51	69	63	133	94	56
73	105	79	72	79	116

1215 $11^h\,40^m$ We 1.106

42	71	76	48	44	25
78	72	58	76	31	47
98	96	99	111	58	57
82	79	73	79	45	44
57	47	39	51	52	29
23	44	33	47	20	37

758 $12^h\,00^m$ Wb 0.906

58	37	42	40	42	76
89	67	43	54	56	74
80	62	44	56	89	100
49	40	94	39	73	85
46	36	40	61	47	60
45	51	94	73	52	36

TABLE VI. (continued)

δ = +10°

2329	$6^h\ 00^m$				
Sm	0.979				
0	1	1	0	1	3
0	0	0	0	4	1
1	0	1	1	3	0
0	0	4	4	4	1
0	0	2	1	1	0
2	0	1	0	1	1

2108	$6^h\ 20^m$				
Sl	0.944				
1	1	0	0	1	0
0	0	0	0	2	0
0	0	0	1	0	1
0	0	0	0	0	0
0	0	0	0	1	0
0	0	0	0	1	0

1826	$6^h\ 40^m$				
Sj	0.916				
1	2	1	0	0	0
0	3	0	1	1	0
1	3	1	0	1	2
2	2	1	0	0	0
0	0	1	0	0	0
0	0	1	0	0	2

1494	$7^h\ 00^m$				
Sh	0.952				
7	4	7	1	8	1
11	10	1	4	1	2
4	10	7	8	5	1
7	11	3	0	1	3
3	7	3	5	8	3
13	4	2	2	1	0

708	$7^h\ 20^m$				
Wb	0.697				
16	18	16	9	7	14
16	15	15	6	6	11
17	14	13	7	18	2
16	9	20	20	18	8
6	7	8	2	3	1
8	8	9	11	9	12

718	$7^h\ 40^m$				
Sb	1.003				
23	21	14	20	24	7
14	17	15	12	16	7
26	24	21	17	27	9
58	26	62	44	16	16
29	16	26	23	10	6
17	11	33	12	10	5

2132	$8^h\ 00^m$				
Sl	0.852				
6	13	27	24	21	20
21	32	23	25	34	17
27	16	43	35	21	25
19	35	28	52	20	48
15	37	44	42	30	20
26	46	35	35	10	14

2152	$8^h\ 20^m$				
Sl	1.447				
24	24	36	17	22	7
20	18	32	18	22	12
29	16	21	14	13	18
28	22	33	13	13	12
16	19	34	22	13	2
7	12	35	30	11	11

771	$8^h\ 40^m$				
Wb	0.657				
29	35	27	28	41	34
36	62	49	58	42	31
34	33	49	41	35	50
55	48	53	35	32	45
49	37	21	31	21	25
30	25	24	22	21	18

2139	$9^h\ 00^m$				
Sl	1.041				
25	26	26	26	28	19
22	31	29	44	49	23
32	30	42	25	33	23
24	23	32	27	43	35
25	25	33	30	34	25
36	30	25	19	30	17

2134	$9^h\ 20^m$				
Sl	1.213				
22	50	29	28	27	17
23	17	35	27	24	22
66	43	17	27	33	17
66	26	22	25	30	19
37	27	53	29	30	19
22	23	32	39	51	24

1131	$9^h\ 40^m$				
Se	0.724				
81	52	24	30	30	44
64	63	66	69	75	46
71	52	44	51	66	81
35	68	47	36	52	67
56	51	57	28	51	46
61	54	47	24	39	27

1567	$10^h\ 00^m$				
Sh	1.256				
34	28	29	27	23	39
29	42	30	48	31	27
36	32	37	42	37	37
53	50	25	25	33	17
43	43	21	24	26	40
32	35	53	38	44	26

1866	$10^h\ 20^m$				
Sj	0.861				
65	50	66	55	48	37
96	72	75	32	32	35
56	128	77	45	42	35
40	72	67	65	68	54
64	76	79	86	55	56
49	22	56	44	36	30

1486	$10^h\ 40^m$				
Wg	0.788				
79	77	72	87	80	75
96	82	80	81	79	103
108	60	67	67	83	40
132	101	76	64	41	30
94	47	71	57	38	65
53	68	43	66	39	63

753	$11^h\ 00^m$				
Sb	0.892				
36	27	53	70	71	68
55	43	36	39	43	50
45	51	39	107	50	71
69	61	61	98	102	99
63	87	55	99	73	78
56	49	98	76	65	40

1163	$11^h\ 20^m$				
Se	0.987				
48	30	41	53	43	28
23	32	28	26	37	42
53	57	48	44	35	62
28	50	47	43	36	60
50	38	57	48	42	50
44	39	48	31	38	43

1573	$11^h\ 40^m$				
Sh	0.819				
89	107	56	75	51	46
50	125	83	114	37	31
49	93	90	195	36	45
90	81	90	64	43	30
86	110	103	78	41	65
57	116	140	71	62	32

1149	$12^h\ 00^m$				
Se	0.999				
60	69	47	42	41	79
65	110	66	51	123	73
71	98	99	93	85	51
75	46	49	48	61	65
51	46	37	37	29	58
68	47	50	39	42	49

δ = +15°

1819	$6^h\ 00^m$				
Sj	0.916				
2	0	0	0	1	0
0	1	0	0	2	4
0	0	0	2	3	3
1	0	0	0	1	2
0	0	0	0	2	1
0	0	0	0	0	2

2142	$6^h\ 20^m$				
Sl	1.127				
0	0	0	0	0	0
0	0	0	0	0	1
0	0	0	0	0	0
0	0	0	0	1	0
0	0	0	0	0	0
0	0	0	0	0	0

1466	$6^h\ 40^m$				
Sg	0.940				
4	3	7	0	0	0
4	3	5	0	0	0
6	1	3	1	1	0
5	2	4	4	1	0
0	0	1	1	0	0
1	2	1	1	0	0

1830	$7^h\ 00^m$				
Wj	1.009				
5	4	6	4	2	2
1	5	9	6	10	6
6	12	15	6	11	6
4	5	11	12	10	8
8	16	13	3	7	0
11	4	5	1	4	2

783	$7^h\ 20^m$				
Sb	0.849				
17	23	29	20	21	4
15	7	9	3	8	2
22	16	11	10	10	9
12	22	11	12	10	8
18	20	5	8	10	4
13	10	13	6	4	9

1106	$7^h\ 40^m$				
Se	0.769				
31	49	42	33	38	19
44	31	17	33	24	13
41	25	18	10	13	15
59	22	20	26	13	11
35	16	19	18	21	24
27	21	17	16	24	4

2341	$8^h\ 00^m$				
Sm	1.606				
29	26	17	10	14	11
22	28	27	32	14	29
18	40	37	34	15	17
10	20	15	11	31	22
11	13	8	12	15	14
6	7	13	8	7	12

1551	$8^h\ 20^m$				
Wh	0.613				
56	98	66	33	37	42
33	39	61	60	58	38
68	72	73	59	54	54
39	48	46	24	27	28
42	50	52	33	34	28
29	39	45	31	34	11

781	$8^h\ 40^m$				
Sb	0.975				
41	35	15	37	29	21
37	18	20	21	17	21
45	48	30	24	39	37
31	45	29	20	24	16
35	41	43	23	20	22
16	27	22	25	32	23

1468	$9^h\ 00^m$				
Wg	0.829				
54	53	96	77	68	36
78	107	49	70	61	28
75	44	64	55	70	59
52	97	85	62	66	43
59	58	70	51	41	30
31	35	27	25	32	15

1831	$9^h\ 20^m$				
Sj	1.069				
24	25	34	30	62	35
27	24	35	40	50	52
28	37	39	56	74	24
28	44	48	63	33	23
28	46	72	31	30	32
24	50	28	31	16	19

791	$9^h\ 40^m$				
Sb	0.892				
34	40	26	39	48	18
37	32	40	37	28	28
46	37	50	44	37	27
22	56	49	39	45	40
49	43	27	49	37	24
59	39	21	29	30	25

1843	$10^h\ 00^m$				
Sj	0.849				
40	68	42	74	39	27
70	77	48	49	83	19
53	58	47	48	49	26
66	85	73	65	52	19
31	50	39	76	49	36
45	37	40	39	38	45

437	$10^h\ 20^m$				
Sa	1.129				
35	55	62	43	37	26
52	37	67	67	54	59
44	44	52	82	69	46
42	43	51	86	67	58
50	35	70	58	47	17
42	35	52	40	27	34

1552	$10^h\ 40^m$				
Sh	0.808				
92	71	41	59	34	33
74	83	84	73	51	68
52	59	48	40	87	40
74	54	80	49	38	42
67	66	52	45	53	70
84	74	79	68	68	77

772	$11^h\ 00^m$				
Wb	0.765				
46	54	57	83	92	73
58	110	77	73	83	95
43	82	65	75	50	48
107	106	56	58	77	65
86	89	78	59	54	56
46	49	72	96	77	54

795	$11^h\ 20^m$				
Sb	0.856				
86	95	68	57	67	35
83	75	52	48	54	70
79	71	55	48	42	46
104	54	46	50	56	78
37	33	31	46	38	66
46	31	35	66	44	25

1875	$11^h\ 40^m$				
Sj	0.824				
46	57	55	79	61	43
72	50	55	51	89	43
95	87	113	72	80	70
93	69	86	58	75	86
132	102	70	76	124	28
97	132	60	83	61	48

1132	$12^h\ 00^m$				
Se	0.810				
73	59	65	56	55	55
79	63	54	61	60	58
120	113	63	85	70	101
157	81	75	56	44	63
150	116	86	96	111	125
77	94	60	55	81	81

TABLE VI. (continued)

$\delta = +20°$

1462 $6^h\ 00^m$ Sg 0.940

2	0	0	1	3	0
1	0	0	0	2	0
0	0	0	0	1	0
1	0	0	0	1	0
0	1	1	1	0	4
1	2	0	0	1	3

2353 $6^h\ 20^m$ Sm 0.991

5	2	1	0	1	0
5	3	0	1	0	0
4	1	0	0	0	0
2	0	0	0	0	0
2	4	0	0	0	0
0	1	0	0	0	0

1475 $6^h\ 40^m$ Sg 1.212

6	4	4	3	9	5
6	2	1	2	2	3
5	14	1	5	0	2
10	6	3	1	1	1
2	5	1	2	0	1
1	3	5	2	0	1

2331 $7^h\ 00^m$ Sg 0.861

6	9	18	16	11	4
14	30	33	14	8	7
10	23	24	12	9	13
23	17	30	13	16	15
19	11	28	11	11	3
6	4	8	4	2	4

735 $7^h\ 20^m$ Wb 0.830

16	20	30	32	21	12
16	22	16	31	24	14
30	31	38	35	17	21
36	28	33	36	19	37
70	50	32	35	30	16
22	18	34	20	16	4

1138 $7^h\ 40^m$ Se 1.208

16	22	30	17	16	15
23	15	18	13	20	22
15	22	11	18	12	14
22	39	19	22	51	20
25	60	49	43	33	49
15	29	26	22	25	8

2491 $8^h\ 00^m$ Sn 1.091

19	19	25	13	20	14
25	27	17	19	16	25
24	31	37	28	20	26
24	26	30	22	35	16
30	27	20	29	28	18
28	20	25	18	14	14

1463 $8^h\ 20^m$ Sg 0.996

47	35	33	51	40	28
41	40	52	96	41	42
25	28	64	54	50	34
50	35	72	29	24	27
36	51	66	47	17	35
26	79	44	21	10	29

777 $8^h\ 40^m$ Sb 1.096

22	30	41	27	17	22
27	35	32	18	21	18
41	27	27	17	19	30
42	71	35	33	38	41
75	58	30	53	42	35
51	39	30	39	39	28

1476 $9^h\ 00^m$ Sg 0.746

44	48	51	51	56	32
33	63	49	79	37	48
43	58	74	94	53	39
46	62	109	55	39	36
46	70	106	57	61	69
60	66	114	78	64	47

2382 $9^h\ 20^m$ Sn 1.565

17	22	75	19	20	17
27	34	32	19	15	12
15	22	21	38	54	18
16	15	25	23	44	29
21	26	33	32	27	12
12	19	22	30	42	19

2573 $9^h\ 40^m$ So 1.252

25	33	47	41	33	25
51	48	46	29	29	30
51	70	15	32	18	21
51	27	23	29	21	17
35	30	19	12	13	17
13	22	23	32	30	10

1135 $10^h\ 00^m$ We 0.850

41	26	37	30	28	24
57	58	41	36	41	58
95	42	27	44	86	69
108	115	72	94	88	67
62	109	84	67	47	40
61	54	44	74	45	23

1817 $10^h\ 20^m$ Sj 0.966

29	54	54	35	38	26
42	63	84	67	46	26
44	61	77	75	43	60
53	45	54	59	47	75
41	65	60	46	22	43
33	55	76	46	35	39

2150 $10^h\ 40^m$ Sl 1.146

60	86	49	33	37	30
47	35	42	39	47	39
40	48	48	20	45	35
55	41	37	44	29	27
54	60	59	51	32	31
58	66	25	33	21	19

782 $11^h\ 00^m$ Sb 1.057

28	55	38	37	43	49
23	59	38	30	54	57
27	38	43	34	63	37
49	58	66	44	56	43
13	32	55	46	35	47
35	25	38	51	60	44

2140 $11^h\ 20^m$ Sl 1.378

55	36	38	36	22	32
83	74	30	44	29	24
59	50	49	40	30	22
33	54	65	66	40	44
57	41	28	31	34	10
36	38	27	37	39	13

809 $11^h\ 40^m$ Sb 0.969

77	94	65	80	80	60
74	99	129	63	132	64
100	82	213	92	90	85
44	65	141	71	40	32
61	41	44	83	99	86
34	35	52	71	58	45

751 $12^h\ 00^m$ Sb 1.002

67	70	97	72	76	77
66	48	85	98	89	119
63	42	142	76	36	106
74	51	59	45	50	50
55	49	50	54	55	47
48	42	43	39	41	39

(2) If the absorbing material lies in a very thin layer of total optical depth $2ak$ distributed symmetrically on either side of the fundamental plane, an external object viewed from this plane and normal to it will be reduced in apparent brightness by a factor e^{-ak}, or by $\Delta m_1 = -2.5 \log e^{-ak}$. On the other hand, if the nebula is viewed normal to its fundamental plane from an external point, the absorbing layer will cause a reduction in brightness by a factor $(1 + e^{-2ak})/2$, or

$$\Delta m_2 = -2.5 \log \frac{1 + e^{-2ak}}{2}. \tag{3}$$

Therefore,

$$\Delta m_1 - \Delta m_2 = 2.5 \log \cosh ak. \tag{4}$$

But,

$$ak = 0.921\ \Delta m_1.$$

Therefore,

$$\Delta m_1 - \Delta m_2 = 2.5 \log \cosh (0.921\ \Delta m_1), \tag{5}$$

and when $\Delta m_1 = 0.46$, $\Delta m_2 = 0.37$.

(3) It is assumed that:

a) throughout the nebula the ratio, γ, of volume emission to absorption coefficients is constant,

b) these coefficients are distributed uniformly on either side of the fundamental plane.

Let τ_0 be the optical depth in absorption of an external object seen from and normal to the fundamental plane. Then

$$\Delta m_1 = 2.5 \log e^{\tau_0} = 1.086\ \tau_0. \tag{6}$$

Let τ be the optical depth in absorption of a point in the nebula as viewed from an external position normal to the fundamental plane. If the point is in that plane, $\tau = \tau_0$. Because of (b) the total optical thickness normal to the fundamental plane is $2\tau_0$. From (a) it is clear that the reduction in brightness due to absorption as seen from the external position is in the ratio

$$\frac{\gamma \int_0^{2\tau_0} e^{-\tau} d\tau}{\gamma \int_0^{\tau_0} d\tau} = \frac{1 - e^{-2\tau_0}}{2\tau_0} \tag{7}$$

but, since $\Delta m_1 = 1.086\ \tau_0$, we find

$$\Delta m_2 = 2.5 \log \frac{1.842\ \Delta m_1}{1 - e^{-1.842\ \Delta m_1}} \tag{8}$$

and when $\Delta m_1 = 0.46$, $\Delta m_2 = 0.42$.

TABLE VII. AREA VII, UNCORRECTED COUNTS OF NEBULAE PER SQUARE DEGREE

$\delta = +20°$

751 $12^{h}\ 00^{m}$ Sb 0.962

67	70	97	72	76	77
66	48	85	98	89	119
63	42	142	76	36	106
74	51	59	45	50	50
55	49	50	54	55	47
48	42	43	39	41	39

757 $12^{h}\ 20^{m}$ Sb 1.016

33	44	55	75	97	46
53	29	67	55	67	49
57	42	76	61	63	53
48	52	43	77	84	53
39	62	59	34	67	53
39	59	61	52	51	40

837 $12^{h}\ 40^{m}$ Wb 1.012

32	32	33	26	33	30
25	28	40	42	36	42
42	43	32	22	44	51
83	58	35	66	32	48
67	44	38	127	39	45
36	40	54	76	63	57

840 $13^{h}\ 00^{m}$ Sb 0.891

55	45	35	29	37	31
61	65	33	37	19	19
65	70	65	41	51	39
86	85	116	103	89	52
71	83	109	87	69	63
50	47	43	36	38	43

1524 $13^{h}\ 20^{m}$ Sh 0.982

37	58	69	74	51	52
31	43	61	68	51	46
35	39	36	47	56	33
50	55	52	35	33	66
59	50	56	41	42	44
31	53	57	48	31	34

1566 $13^{h}\ 40^{m}$ Sh 0.789

78	51	51	44	48	28
82	51	48	63	41	24
74	39	66	51	42	43
93	87	68	42	37	39
78	155	135	116	63	70
80	97	96	66	59	38

1577 $14^{h}\ 00^{m}$ Sh 0.847

54	51	42	66	95	62
75	55	54	58	92	53
90	52	41	83	91	54
95	103	57	58	91	75
86	70	54	57	72	70
44	63	76	69	57	60

1253 $14^{h}\ 20^{m}$ Wf 1.347

40	24	35	27	21	27
32	41	36	43	30	44
46	51	47	25	41	56
53	47	51	33	52	79
57	44	35	89	60	63
78	86	103	59	46	39

1591 $14^{h}\ 40^{m}$ Sh 0.743

119	110	118	97	82	63
107	95	54	86	67	66
82	97	91	78	64	76
73	75	107	87	76	77
134	99	56	68	95	52
118	93	42	78	85	57

1571 $15^{h}\ 00^{m}$ Sh 1.127

36	53	39	50	70	61
38	58	86	85	64	60
58	89	80	50	63	48
75	69	41	80	73	55
09	46	36	41	103	90
66	53	39	37	34	80

1560 $15^{h}\ 20^{m}$ Sh 0.978

37	38	31	52	42	32
51	48	55	58	29	31
30	32	72	58	56	55
31	41	70	58	65	75
44	56	40	35	69	96
32	39	32	21	47	67

506 $15^{h}\ 40^{m}$ Sa 0.805

51	38	53	83	76	62
67	53	42	114	74	59
74	56	40	39	42	23
91	111	38	61	44	49
86	82	52	65	39	38
34	39	60	50	22	19

1239 $16^{h}\ 00^{m}$ Sf 1.089

39	37	39	46	25	37
45	35	47	52	41	56
36	30	71	70	66	64
29	47	64	71	60	53
49	76	151	119	91	38
70	114	192	78	45	30

1262 $16^{h}\ 20^{m}$ Wf 0.922

40	30	39	42	23	52
80	54	50	53	44	54
71	61	60	50	46	42
52	44	41	48	76	38
41	31	38	59	41	42
18	31	39	37	28	55

848 $16^{h}\ 40^{m}$ Wb 0.931

41	21	25	30	34	34
27	19	27	15	27	48
32	33	27	27	21	36
35	17	25	33	26	38
39	26	28	22	29	38
44	33	28	10	27	20

519 $17^{h}\ 00^{m}$ Sa 0.731

36	33	32	36	33	22
40	40	41	19	25	38
24	32	19	30	22	30
30	32	23	22	33	15
20	36	35	30	41	7
17	10	11	16	24	29

833 $17^{h}\ 20^{m}$ Sb 1.221

19	21	23	18	13	21
15	16	20	23	25	21
31	24	22	19	28	19
18	37	32	21	18	11
34	19	15	21	20	10
19	18	14	10	7	13

1272 $17^{h}\ 40^{m}$ Sf 2.181

9	9	5	8	6	9
7	4	3	7	7	5
8	6	7	6	6	6
7	4	9	8	7	9
10	6	7	9	5	5
10	17	7	11	11	2

507 $18^{h}\ 00^{m}$ Sa 1.053

9	18	9	10	11	4
35	18	22	10	16	11
7	11	26	14	12	14
3	5	13	14	17	7
16	3	6	10	33	14
8	9	9	8	4	15

$\delta = +25°$

732 $12^{h}\ 00^{m}$ Wb 1.025

57	58	44	47	91	58
30	72	46	70	74	47
36	134	61	96	115	66
53	76	80	89	67	62
57	67	89	66	113	98
49	55	73	55	73	75

1497 $12^{h}\ 20^{m}$ Sh 0.791

95	94	93	110	92	74
68	79	66	68	62	77
62	111	110	74	67	106
82	59	62	56	69	62
79	67	85	65	67	78
34	47	49	81	96	57

1194 $12^{h}\ 40^{m}$ We 0.682

135	111	88	90	125	75
76	60	97	89	78	43
49	86	59	76	46	57
35	73	38	52	90	56
42	60	55	44	80	58
47	45	42	51	54	29

1553 $13^{h}\ 00^{m}$ Wh 0.677

67	80	94	227	191	116
80	81	77	61	85	53
74	74	90	61	77	59
68	93	70	111	43	54
63	79	83	48	60	61
61	85	67	56	55	58

1175 $13^{h}\ 20^{m}$ We 0.847

42	50	82	54	45	58
78	76	73	69	51	55
74	75	44	44	37	38
67	63	76	60	47	57
51	66	77	70	47	57
39	45	68	72	61	54

2543 $13^{h}\ 40^{m}$ So 1.391

56	85	50	50	21	20
37	105	108	108	65	49
105	118	43	53	[illegible]	47
76	56	51	46	41	31
38	51	53	36	40	25
46	29	40	32	28	13

1876 $14^{h}\ 00^{m}$ Wj 0.770

104	72	93	109	105	100
132	153	126	142	104	121
111	120	109	97	187	162
123	99	125	80	124	131
89	99	77	85	96	73
69	68	56	80	114	79

1530 $14^{h}\ 20^{m}$ Sh 0.673

73	64	74	71	78	66
122	104	182	109	104	115
102	128	123	99	66	123
118	133	78	57	86	97
161	140	83	60	79	52
71	58	74	74	44	54

2202 $14^{h}\ 40^{m}$ Wm 1.081

30	43	51	46	32	29
35	60	49	30	64	61
82	52	65	53	62	81
66	66	79	48	92	75
54	78	60	112	92	79
79	76	74	68	76	52

1195 $15^{h}\ 00^{m}$ Se 0.798

63	105	78	50	44	31
51	83	118	70	42	65
78	99	90	105	92	69
55	41	66	84	72	75
50	44	76	81	58	40
70	73	41	61	98	56

1642 $15^{h}\ 20^{m}$ Sh 0.959

68	73	166	145	79	88
36	47	52	63	41	40
58	46	46	54	57	56
69	30	32	44	41	39
51	30	33	40	38	33
34	35	35	50	36	24

1176 $15^{h}\ 40^{m}$ Se 1.001

115	33	45	36	75	40
82	55	45	41	49	33
66	78	57	50	97	35
67	36	50	57	64	58
53	32	52	54	49	42
44	38	44	76	52	28

2166 $16^{h}\ 00^{m}$ Wl 0.889

67	72	72	129	104	61
70	85	76	125	80	58
59	56	73	59	74	60
62	39	88	46	73	50
69	54	63	30	41	47
54	46	50	57	41	52

1266 $16^{h}\ 20^{m}$ Sf 0.982

53	59	46	45	75	45
112	90	66	71	62	57
100	109	78	97	50	50
56	88	97	107	48	37
48	44	79	43	50	47
32	31	44	47	32	38

1578 $16^{h}\ 40^{m}$ Wh 0.727

44	89	56	58	62	52
55	80	73	96	154	88
49	43	57	66	74	108
75	75	51	41	32	79
85	72	36	62	44	39
43	34	47	31	41	43

518 $17^{h}\ 00^{m}$ Sa 1.472

19	36	14	51	32	22
18	30	20	17	37	28
16	28	42	35	24	17
17	21	40	32	25	38
23	8	21	20	43	57
7	25	24	14	17	19

1679 $17^{h}\ 20^{m}$ Wi 0.574

21	35	77	72	42	56
28	57	53	43	41	52
56	40	37	42	37	36
25	39	40	52	53	39
35	51	56	55	55	26
28	37	30	26	28	28

1681 $17^{h}\ 40^{m}$ Si 1.269

14	15	9	8	11	6
22	16	25	25	15	24
21	25	31	25	35	24
19	24	22	27	21	15
14	13	17	20	12	13
13	9	13	12	15	12

1955 $18^{h}\ 00^{m}$ Wk 0.589

21	15	35	39	44	36
25	30	39	24	28	30
49	37	33	39	39	56
33	38	26	36	46	29
20	26	23	27	20	23
23	45	23	22	24	15

TABLE VII. (continued)

δ = +30°

785 $12^h 00^m$ Sb 0.974

50	88	79	65	67	48
47	68	62	62	50	36
109	62	62	91	61	26
82	78	66	80	40	55
73	72	124	55	36	57
49	55	37	37	74	43

1598 $12^h 20^m$ Wh 0.681

43	49	109	55	76	83
55	102	158	94	68	104
41	102	72	120	127	85
98	91	67	94	86	116
69	104	101	165	116	71
90	105	112	128	86	68

1213 $12^h 40^m$ Se 1.300

26	22	20	34	22	20
37	25	34	19	25	39
43	49	40	22	24	35
37	40	25	28	37	64
63	39	46	44	43	30
75	72	34	46	72	34

1613 $13^h 00^m$ Wh 0.645

69	87	73	69	52	47
91	72	66	119	82	73
111	74	59	75	81	83
76	74	114	119	94	94
93	102	138	395	156	62
76	69	90	215	190	128

1881 $13^h 20^m$ Wj 0.816

80	113	116	76	64	83
85	95	108	128	79	53
62	71	60	81	85	60
81	44	44	59	86	71
60	58	42	57	82	83
40	47	83	47	37	43

1581 $13^h 40^m$ Wh 0.757

64	110	55	60	86	96
83	65	72	98	68	88
74	77	155	116	62	60
128	158	110	120	118	54
125	188	91	98	85	50
116	162	87	86	57	47

2203 $14^h 00^m$ Sm 0.666

45	74	49	79	51	89
71	40	39	38	81	53
68	73	59	90	69	62
78	77	89	81	59	138
125	89	113	264	135	123
101	67	85	84	93	96

1886 $14^h 20^m$ Sj 1.151

35	45	43	39	29	37
50	72	46	38	53	32
65	68	58	79	51	46
63	53	79	69	64	48
64	49	53	57	60	63
30	38	45	50	45	41

1599 $14^h 40^m$ Sh 0.703

55	67	59	35	30	41
100	84	74	55	58	65
87	118	65	86	79	77
74	83	50	60	83	44
75	82	48	55	78	62
49	70	67	76	57	41

1219 $15^h 00^m$ Sf 1.079

42	46	51	79	51	46
89	54	80	51	82	75
52	63	64	50	61	93
39	72	69	73	41	56
89	62	123	75	69	72
46	86	60	45	37	27

1870 $15^h 20^m$ Sj 0.858

42	70	107	109	66	49
144	69	177	102	87	74
106	140	195	181	87	95
65	201	187	122	59	51
98	136	182	162	110	63
66	74	169	140	77	56

1882 $15^h 40^m$ Sj 0.915

43	62	42	58	42	61
40	45	25	49	119	64
59	56	50	67	74	71
75	83	36	42	63	138
71	108	73	68	63	72
148	35	53	41	61	40

1214 $16^h 00^m$ Se 1.089

47	37	38	40	35	30
82	51	58	49	37	23
89	65	64	37	54	45
96	54	55	58	63	60
53	58	56	58	76	72
66	69	60	117	97	69

1228 $16^h 20^m$ Wf 0.710

40	53	43	34	46	76
67	42	35	58	97	73
42	56	91	93	111	95
53	52	48	100	86	132
58	74	69	69	86	94
68	53	58	51	78	57

1659 $16^h 40^m$ Si 1.269

28	44	33	51	20	17
36	35	46	32	47	26
57	51	42	40	22	16
52	56	44	52	32	28
31	37	32	66	40	19
38	77	63	39	36	33

843 $17^h 00^m$ Wb 0.615

58	51	54	111	75	64
52	81	94	63	65	65
52	65	68	48	79	66
57	55	59	56	68	72
43	58	91	84	50	56
40	54	30	82	60	54

1897 $17^h 20^m$ Sj 1.144

13	26	28	24	20	24
29	47	41	24	35	34
26	22	53	45	35	32
11	25	27	34	34	24
10	18	17	42	28	46
14	25	49	34	21	29

1682 $17^h 40^m$ Wi 0.696

30	30	33	31	21	25
32	33	28	22	27	40
37	35	30	16	27	22
32	37	24	32	34	32
24	31	27	15	10	8
26	35	22	14	8	15

1923 $18^h 00^m$ Sk 1.449

6	8	13	3	28	28
13	12	15	33	20	19
18	30	20	12	29	14
15	15	44	25	23	26
15	21	27	31	23	13
8	10	13	21	20	3

δ = +35°

1200 $12^h 00^m$ Se 0.855

51	92	68	66	45	39
87	129	66	88	86	71
61	68	58	77	60	52
61	50	46	60	59	42
62	90	85	101	70	46
48	85	88	57	54	39

1847 $12^h 20^m$ Wj 0.815

40	45	38	41	37	83
53	72	52	50	66	92
55	65	34	37	54	57
80	56	38	52	54	51
62	53	63	71	45	78
33	43	107	55	50	69

1221 $12^h 40^m$ We 0.850

22	21	24	28	23	27
41	34	47	34	32	48
50	45	31	39	51	33
35	34	51	50	64	31
57	53	57	68	47	43
34	34	34	46	37	38

1205 $13^h 00^m$ We 0.604

67	61	56	79	56	40
70	69	93	76	78	55
61	83	68	65	88	75
109	100	75	40	35	45
63	72	85	57	54	49
58	71	53	63	41	38

1624 $13^h 20^m$ Wh 0.869

81	88	63	51	44	30
121	63	67	51	58	52
101	60	51	51	58	71
127	84	47	103	91	96
122	67	97	129	76	55
92	122	112	88	58	72

1858 $13^h 40^m$ Sj 0.791

99	55	50	41	99	131
126	88	69	55	141	62
125	89	56	60	104	43
126	86	49	62	116	65
149	97	49	53	101	76
62	104	45	49	69	84

2186 $14^h 00^m$ Wm 0.771

59	85	70	73	110	56
110	63	63	74	82	68
87	65	63	96	124	92
56	44	32	81	106	69
39	66	92	90	139	94
48	77	73	82	61	81

1859 $14^h 20^m$ Sj 0.809

32	76	64	58	44	48
76	81	71	72	89	64
80	82	77	76	45	38
64	65	61	56	37	37
47	66	60	33	26	27
30	36	53	39	21	40

2418 $14^h 40^m$ Wm 1.069

31	26	34	36	25	37
23	40	44	41	49	53
32	53	49	36	56	59
37	68	41	31	40	40
52	63	50	35	29	56
43	44	43	19	19	23

495 $15^h 00^m$ Sa 1.044

33	55	40	36	32	32
47	105	111	54	36	33
84	70	90	48	48	51
51	71	41	57	50	41
36	71	29	45	46	44
49	43	48	81	43	28

1206 $15^h 20^m$ Se 0.962

38	29	59	37	28	51
46	38	65	50	44	80
60	54	37	39	67	50
67	52	36	60	70	82
82	80	92	105	67	74
50	66	85	81	46	36

1625 $15^h 40^m$ Sh 0.933

28	46	32	30	53	17
58	50	114	33	44	32
65	54	81	58	48	38
82	66	93	66	47	37
63	90	67	69	56	51
48	57	58	68	53	57

1582 $16^h 00^m$ Wh 0.809

68	87	70	62	42	51
37	66	56	52	59	36
70	55	38	88	75	57
38	60	64	74	84	60
59	79	121	79	88	72
54	60	46	52	54	48

1268 $16^h 20^m$ Sf 0.979

39	28	75	72	58	71
43	43	52	48	38	62
37	44	64	101	73	41
26	34	47	85	47	55
34	32	45	46	59	45
19	33	36	27	37	39

1594 $16^h 40^m$ Wh 0.542

69	42	66	86	60	33
67	54	52	77	70	64
64	68	65	53	58	56
73	64	58	74	41	45
71	61	53	72	63	50
71	85	64	96	47	32

883 $17^h 00^m$ Sb 0.775

53	47	63	51	44	27
46	50	79	39	48	36
71	64	92	53	43	47
64	148	121	68	44	31
57	93	180	83	54	39
29	42	41	87	50	44

1899 $17^h 20^m$ Wj 0.764

24	25	14	24	35	40
67	50	34	36	46	40
43	35	38	46	57	51
39	39	48	68	52	89
50	23	48	41	59	40
23	32	36	40	23	29

1900 $17^h 40^m$ Sj 1.258

31	20	16	23	22	16
9	9	21	22	52	21
9	12	23	54	18	18
15	26	22	35	19	10
14	27	40	20	24	8
34	24	26	17	18	7

1922 $18^h 00^m$ Wk 0.661

38	35	22	29	72	39
39	37	18	38	25	17
42	23	29	26	18	17
37	15	18	18	36	29
24	23	22	24	26	23
19	21	27	14	48	27

TABLE VII. (continued)

δ = +40°

1525 $12^h\ 00^m$ Sh 0.715

100	72	99	67	56	63
129	113	71	84	53	44
66	90	69	35	41	44
58	71	108	62	45	28
41	58	56	65	29	41
36	72	57	50	37	38

1600 $12^h\ 24^m$ Sh 0.704

79	53	43	43	80	41
69	66	72	65	83	59
37	57	66	56	59	56
50	40	48	41	59	36
63	45	45	35	45	55
40	51	47	36	28	36

1570 $12^h\ 48^m$ Wh 1.190

20	34	21	37	61	39
29	25	38	56	42	31
102	81	64	36	31	30
49	56	59	36	31	30
50	40	41	23	25	22
29	37	20	18	34	18

461 $13^h\ 12^m$ Sa 0.932

44	57	69	47	29	21
41	56	85	53	36	41
44	59	53	76	130	97
56	64	67	169	58	92
65	54	80	51	49	66
75	73	43	41	17	37

1896 $13^h\ 36^m$ Sj 1.003

8	28	25	49	36	55
0	56	36	53	37	29
5	52	42	32	53	51
6	48	57	89	58	58
5	57	56	98	86	31
0	37	25	59	96	49

2187 $14^h\ 00^m$ Sm 0.838

50	59	30	33	23	43
80	67	40	35	39	45
66	66	64	33	80	63
65	68	67	89	80	77
48	59	51	67	96	93
35	41	49	36	97	29

2196 $14^h\ 24^m$ Sm 1.055

28	27	34	33	42	33
27	27	38	30	41	42
26	32	38	67	43	32
30	20	18	47	38	45
32	20	40	42	33	37
47	25	52	35	23	27

1638 $14^h\ 48^m$ Wh 0.772

51	30	41	29	29	23
24	42	40	42	38	18
59	40	41	26	39	42
47	57	49	34	36	51
77	77	51	53	34	42
54	53	52	45	23	28

1611 $15^h\ 12^m$ Sh 0.816

43	66	45	52	59	43
46	58	62	61	45	42
35	40	46	52	46	42
49	43	33	36	40	43
41	56	40	32	54	47
36	53	35	61	61	65

462 $15^h\ 36^m$ Wa 0.767

8	53	46	44	44	33
3	57	79	68	47	52
0	50	56	62	45	44
6	54	48	49	37	54
6	34	63	64	46	50
0	40	41	77	28	35

1593 $16^h\ 00^m$ Sh 0.828

39	71	46	37	37	42
48	53	58	44	78	27
65	33	54	59	59	40
73	62	49	45	64	27
84	75	46	37	41	43
73	93	65	49	32	42

1575 $16^h\ 24^m$ Wh 0.845

43	54	51	52	56	39
37	66	135	83	72	38
92	95	169	86	56	46
75	69	207	89	41	45
34	30	56	88	64	46
45	48	37	76	49	59

1904 $16^h\ 48^m$ Sj 1.463

39	28	33	27	30	27
49	27	36	24	14	27
45	46	43	48	36	40
56	65	45	43	37	17
44	37	35	24	16	15
31	23	23	10	33	20

1674 $17^h\ 12^m$ Si 1.019

36	31	58	62	58	32
21	47	67	46	60	39
25	41	52	83	57	42
32	52	81	109	62	48
15	35	83	76	43	31
13	16	32	38	33	32

1898 $17^h\ 36^m$ Sj 0.863

3	24	19	26	21	25
6	22	31	42	31	35
4	34	49	39	37	26
7	74	47	27	38	34
9	58	38	30	30	31
8	26	40	32	30	11

1652 $18^h\ 00^m$ Si 0.923

34	40	59	61	32	16
46	43	32	45	44	26
17	23	25	35	50	48
27	31	40	49	33	42
30	26	36	34	38	45
33	17	18	30	60	22

δ = +45°

1892 $12^h\ 00^m$ Sj 1.234

40	28	36	37	32	28
39	27	32	50	27	20
49	39	24	44	26	26
71	49	24	42	67	42
37	30	79	51	54	24
22	35	47	22	14	19

1596 $12^h\ 24^m$ Wh 1.171

28	40	40	38	48	37
28	29	27	67	34	20
36	21	40	46	37	21
28	31	18	38	56	37
36	50	45	42	39	39
39	37	23	29	45	22

1860 $12^h\ 48^m$ Sj 0.635

57	52	54	50	49	37
55	70	57	50	43	36
94	56	102	48	69	45
89	53	50	46	59	41
82	57	43	39	49	59
54	56	38	58	84	72

1619 $13^h\ 12^m$ Wh 0.843

44	27	79	68	62	39
36	34	39	86	40	37
51	58	73	111	55	34
59	55	91	59	55	25
48	68	118	93	94	39
63	88	97	58	48	26

2165 $13^h\ 36^m$ Sl 1.225

9	36	28	34	24	15
5	41	42	28	34	21
5	59	36	36	29	27
7	38	45	47	35	40
2	27	34	41	15	28
9	25	15	35	22	32

2190 $14^h\ 00^m$ Sm 1.030

22	32	25	42	33	25
29	33	40	53	83	50
33	33	26	40	38	41
28	36	40	25	40	32
43	35	33	40	45	37
37	31	17	26	22	15

1893 $14^h\ 24^m$ Sj 1.285

11	12	24	44	18	27
27	36	37	40	30	28
17	41	31	27	26	33
32	25	30	57	27	39
23	36	35	27	28	45
18	21	29	22	32	33

1905 $14^h\ 48^m$ Sj 0.953

35	59	43	37	34	24
32	27	36	48	62	58
49	44	22	21	35	79
25	34	17	28	28	21
40	26	14	27	24	36
50	26	28	30	36	23

1862 $15^h\ 12^m$ Wj 0.662

43	31	62	48	78	108
46	43	45	62	47	35
82	75	76	38	49	44
73	92	88	38	42	52
67	60	64	47	65	53
51	51	50	52	72	50

500 $15^h\ 36^m$ Sa 1.235

1	28	41	27	24	18
2	31	49	31	37	27
5	47	35	40	50	35
5	43	37	26	52	32
5	36	22	44	32	19
2	35	24	23	26	15

1260 $16^h\ 00^m$ Wf 0.799

27	38	52	43	28	36
38	25	29	44	46	32
42	37	49	53	54	46
34	60	37	35	25	33
55	48	45	32	32	41
36	53	42	40	48	43

1655 $16^h\ 24^m$ Si 0.992

40	38	32	34	33	26
45	34	40	40	36	34
40	37	30	43	24	25
54	63	53	51	33	41
38	38	43	45	53	36
37	47	56	37	39	27

1670 $16^h\ 48^m$ Wi 0.817

35	44	40	29	40	37
38	55	57	47	54	45
32	44	63	46	29	31
39	53	53	66	44	89
39	60	58	44	45	26
72	76	66	51	59	41

1661 $17^h\ 12^m$ Si 0.910

33	22	32	32	37	39
40	41	26	26	30	40
40	42	53	31	35	46
62	33	72	52	54	43
44	39	101	65	48	31
48	33	67	72	60	24

1908 $17^h\ 36^m$ Sj 0.886

8	22	41	52	28	17
7	27	31	27	40	46
4	49	20	32	20	29
8	19	22	26	36	20
3	17	35	44	42	31
7	23	27	27	29	24

501 $18^h\ 00^m$ Sa 1.054

35	33	44	30	18	21
26	58	36	34	24	9
23	26	62	49	47	36
14	24	55	43	32	23
29	26	20	30	35	16
24	29	50	44	20	16

TABLE VII. (continued)

δ = +50°

2159	Wl		$12^h\ 00^m$	0.861	
48	34	86	66	60	45
55	84	120	81	59	46
40	72	75	73	65	39
68	52	49	45	70	23
53	53	66	49	56	25
47	53	49	46	44	25

1850	Sj		$12^h\ 24^m$	0.771	
43	51	65	57	42	42
84	67	75	57	76	107
69	126	65	66	51	64
51	63	67	80	101	53
56	87	44	54	72	40
50	59	54	53	59	39

1861	Wj		$12^h\ 48^m$	0.660	
92	72	78	76	55	47
100	118	103	100	65	89
110	130	76	98	119	132
111	72	83	75	61	66
87	97	78	68	58	83
84	84	75	52	71	52

1869	Sj		$13^h\ 12^m$	0.890	
25	53	68	44	48	46
23	43	58	79	68	71
33	42	27	72	71	57
37	38	49	92	89	38
34	48	63	87	51	60
53	50	101	79	66	40

1894	Wj		$13^h\ 36^m$	0.721	
46	36	51	42	35	45
29	32	36	38	30	46
54	65	54	55	32	39
36	48	67	33	24	30
43	72	65	41	36	36
35	45	51	64	52	37

2192	Sm		$14^h\ 00^m$	0.977	
41	35	34	37	32	29
34	18	35	34	36	31
47	37	36	37	38	36
30	44	48	66	33	29
28	41	54	40	20	39
27	23	21	32	22	25

2198	Sm		$14^h\ 24^m$	0.771	
34	59	33	34	55	46
50	66	39	47	31	23
52	75	46	40	49	55
38	54	61	66	48	55
53	66	41	152	32	51
45	44	50	60	34	33

1559	Wh		$14^h\ 48^m$	0.659	
49	60	46	46	47	52
32	37	70	46	82	46
44	81	75	55	55	69
78	120	104	54	60	78
75	97	58	46	66	47
76	141	86	80	56	49

1614	Sh		$15^h\ 12^m$	0.867	
26	36	36	55	39	24
52	45	40	33	32	29
43	48	34	23	39	51
46	52	56	27	54	90
39	91	52	45	58	79
32	26	37	33	43	89

479	Wa		$15^h\ 36^m$	0.835	
32	44	38	36	18	17
35	37	39	33	41	37
66	35	37	33	36	38
30	32	31	37	29	42
43	37	68	33	39	60
33	47	59	39	18	17

2215	Sm		$16^h\ 00^m$	1.299	
35	53	43	35	20	10
40	48	26	28	24	13
86	36	30	29	37	19
45	48	39	26	15	15
18	45	43	38	32	13
10	22	27	29	24	17

1252	Wf		$16^h\ 24^m$	0.924	
25	39	26	59	57	50
60	43	55	77	49	32
38	101	77	74	101	36
56	58	55	47	91	72
45	44	94	40	42	45
53	37	44	46	29	30

1669	Si		$16^h\ 48^m$	0.778	
44	31	44	56	38	53
48	41	45	83	70	42
57	45	43	46	42	101
43	50	44	50	57	56
38	50	33	58	65	31
43	50	53	47	53	41

1641	Wh		$17^h\ 12^m$	0.667	
63	64	74	52	45	35
64	51	61	56	40	34
54	51	67	50	55	46
48	54	90	41	44	37
40	43	55	68	44	47
48	36	40	54	61	43

1684	Si		$17^h\ 36^m$	1.182	
39	23	20	19	22	30
47	32	46	30	27	31
13	26	38	44	32	33
17	24	22	34	23	27
38	24	24	45	17	20
18	18	33	35	18	5

1283	Wf		$18^h\ 00^m$	0.857	
16	23	37	24	34	22
20	24	26	37	61	36
23	31	28	36	23	20
36	68	15	24	24	18
24	30	23	46	34	20
44	38	36	42	25	19

δ = +55°

2171	Sl		$11^h\ 44^m$	1.395	
35	31	31	43	50	50
59	70	71	50	60	57
50	66	85	70	107	45
57	40	67	40	38	49
25	61	62	43	24	19
65	28	45	31	23	19

1589	Wh		$12^h\ 16^m$	0.706	
71	65	80	74	96	72
58	64	86	71	104	166
67	37	83	65	70	113
35	75	53	70	93	75
78	86	67	64	71	64
42	64	52	37	58	84

1867	Sj		$12^h\ 48^m$	1.017	
35	36	42	61	45	41
73	36	12	33	26	43
74	72	62	73	59	22
77	51	32	36	28	28
66	53	71	49	60	47
57	51	40	38	24	32

478	Wa		$13^h\ 20^m$	0.756	
65	59	77	49	44	32
92	51	39	62	80	51
103	79	77	55	58	87
74	95	63	77	76	85
67	53	55	87	95	69
46	34	67	73	46	41

2179	Sl		$13^h\ 52^m$	1.751	
23	24	30	28	18	22
5	33	21	39	41	22
61	36	31	13	56	36
37	19	24	26	20	15
28	15	15	20	13	12
22	19	13	11	22	15

1907	Wj		$14^h\ 24^m$	0.748	
31	39	63	38	48	45
54	68	46	62	27	58
78	86	69	39	77	98
56	46	93	57	67	83
31	82	53	41	63	84
45	69	38	38	60	53

1222	Sf		$14^h\ 56^m$	1.028	
36	22	20	34	48	44
43	32	46	27	57	46
30	35	52	62	74	62
32	46	68	85	42	36
23	36	62	53	14	29
37	42	32	27	31	23

1620	Wh		$15^h\ 28^m$	0.741	
31	63	55	49	66	22
71	88	62	59	59	42
81	51	51	57	45	45
70	68	63	65	36	55
71	63	61	66	27	31
52	48	46	37	16	28

1241	Wf		$16^h\ 00^m$	1.111	
54	35	25	21	26	20
61	75	24	29	37	56
51	60	57	22	40	49
46	56	71	65	38	39
69	78	75	88	87	45
50	52	36	42	32	31

1657	Wi		$16^h\ 32^m$	0.783	
25	32	40	57	102	54
35	49	49	53	79	116
43	38	90	96	86	75
82	49	62	44	87	70
81	35	58	36	72	58
57	46	50	43	52	73

1671	Si		$17^h\ 04^m$	0.894	
102	185	78	40	35	29
47	37	81	52	26	30
45	26	44	47	25	25
33	35	31	29	56	59
57	37	49	31	46	62
40	49	28	21	15	42

1643	Wh		$17^h\ 36^m$	0.792	
55	52	39	24	57	97
51	63	49	50	43	36
65	92	67	48	26	40
76	70	40	34	47	23
56	69	48	64	64	35
44	39	32	39	44	26

886	Sb		$18^h\ 08^m$	1.097	
30	15	32	76	50	19
19	37	69	84	43	44
32	33	19	29	36	29
19	17	31	25	43	37
17	23	39	35	22	37
17	25	16	24	33	25

In our galaxy the obscuring matter no doubt has a distribution somewhere intermediate between that represented by cases (2) and (3). Holmberg's determination of $\Delta m_2 = 0.43$ for Sa. and Sb nebulae is reasonably consistent with our values calculated from $\Delta m_1 = 0.46$.

From this discussion of galactic extinction the photographic region it appears that the commonly used value 0.25 mag. is very probably to low, and that it may well be greater than 0. mag. On the other hand, our value of 0.46 ma could be too high, because of the increased likel

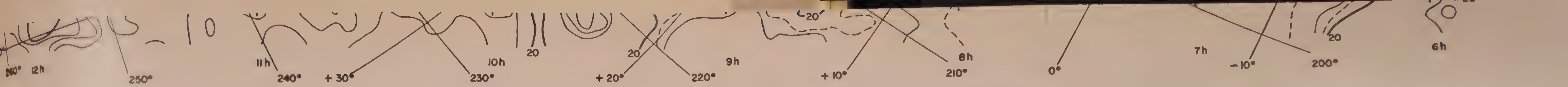


Figure 3. Equal surface density contours for nebulae in Area II, based on smoothed counts by 1° squares.

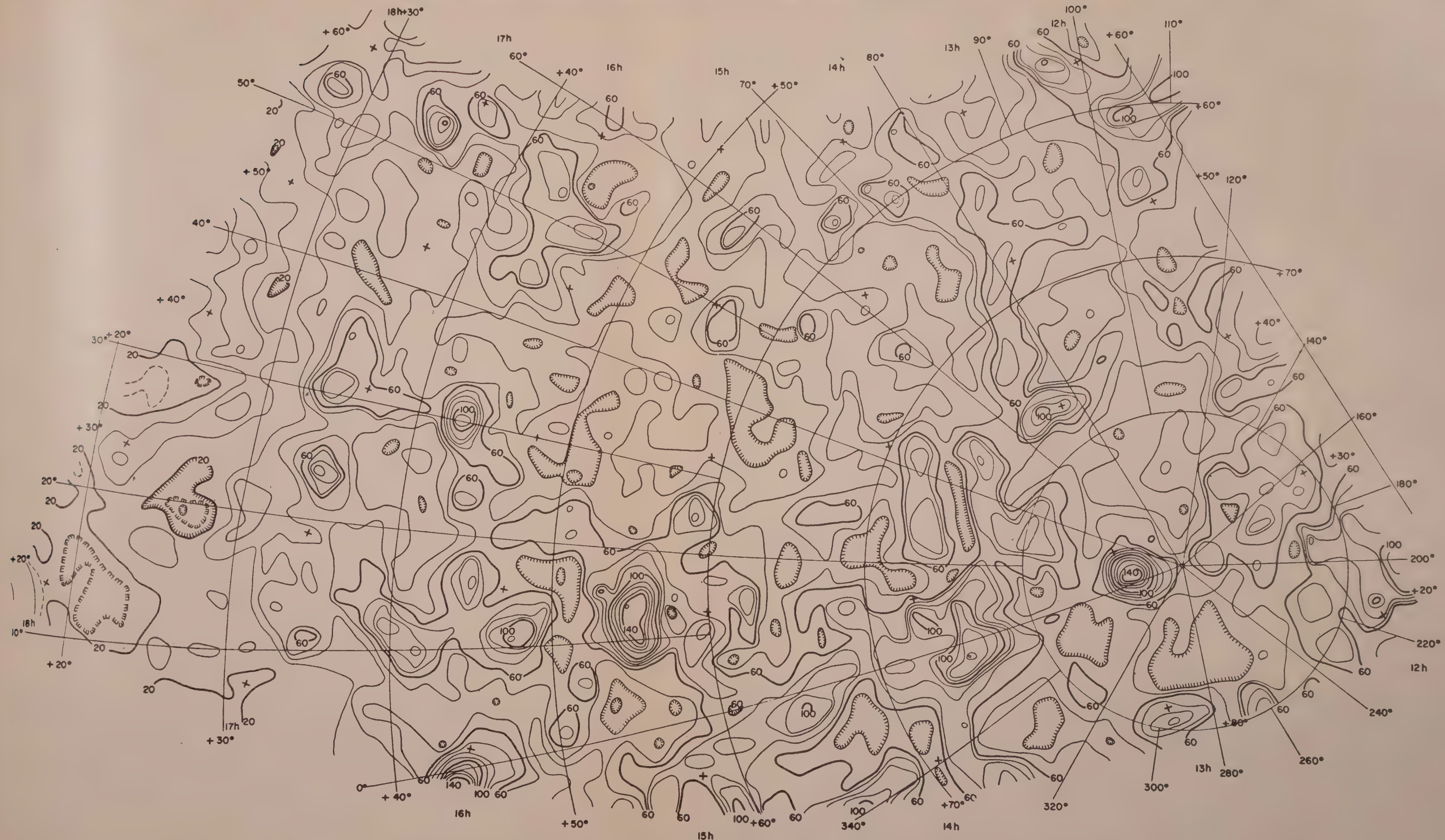
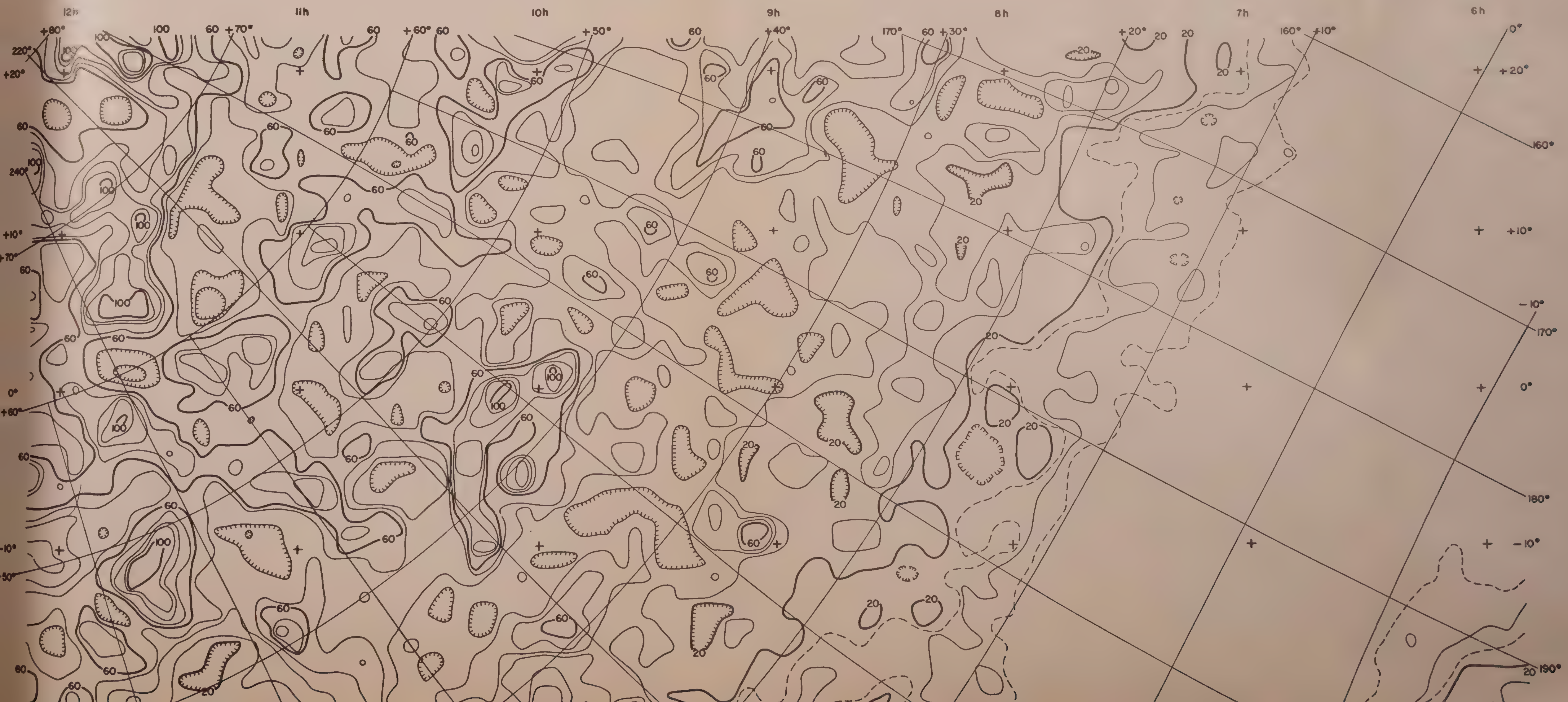


Figure 4. Equal surface density contours for nebulae in Area VII, based on smoothed counts by 1° squares.



12h
11h
10h
9h
8h
7h
6h
+80°
+70°
+60°
+50°
+40°
+30°
+20°
+10°
0°
-10°
160°
170°
180°
190°
220°
240°

TABLE VII. (continued)

$\delta = +60°$

1885 $12^h\,00^m$ Sj 0.894

82	59	79	49	52	55
97	78	56	35	36	56
56	144	76	49	39	66
36	97	87	62	55	50
50	73	80	83	51	61
51	66	70	51	63	51

1520 $12^h\,36^m$ Sh 0.932

65	51	35	26	65	49
42	30	31	33	70	76
33	49	35	33	44	123
75	53	34	51	32	55
41	32	46	48	65	50
34	57	40	56	45	41

1622 $13^h\,12^m$ Sh 0.781

55	51	74	41	56	52
57	62	61	64	71	23
103	49	58	60	37	41
140	73	57	35	53	37
62	86	84	40	50	21
71	135	72	41	52	26

1901 $13^h\,48^m$ Sj 0.990

30	41	28	31	40	24
27	32	28	45	39	44
38	35	19	43	44	59
37	59	41	44	67	48
53	52	52	47	47	46
44	31	31	37	40	40

1919 $14^h\,24^m$ Sj 0.973

34	41	22	38	25	40
39	56	37	27	31	31
24	59	33	33	29	37
31	38	39	23	39	40
36	46	47	34	49	49
39	43	44	24	48	31

1226 $15^h\,00^m$ Sf 0.897

36	33	53	28	44	45
37	56	54	32	32	46
42	38	36	36	52	48
61	40	38	43	32	38
43	39	30	27	38	47
42	35	21	24	32	35

1651 $15^h\,36^m$ Si 1.016

49	44	34	39	33	20
70	53	61	47	30	25
73	45	40	46	20	20
56	41	48	52	30	38
44	40	34	45	30	32
33	33	41	52	34	42

1264 $16^h\,12^m$ Wf 0.991

37	25	40	31	50	34
26	11	60	49	52	53
44	46	56	45	46	39
32	48	45	27	46	31
81	76	61	98	46	28
39	79	55	41	28	18

1649 $16^h\,48^m$ Si 0.839

35	65	59	55	34	32
41	45	53	77	48	19
84	86	51	44	48	50
68	107	101	64	42	54
86	76	65	64	72	82
49	43	19	32	45	33

1628 $17^h\,24^m$ Wh 0.993

45	35	29	18	33	40
31	26	13	30	39	39
26	29	57	53	43	60
62	34	53	64	52	58
43	41	72	55	39	31
44	34	48	76	118	34

1920 $18^h\,00^m$ Sk 0.898

14	27	34	65	42	21
24	34	43	28	31	17
36	29	41	22	32	25
34	41	49	44	58	37
30	40	41	30	32	36
20	53	96	58	29	36

hood of missing nebulae in the rich star fields of low latitude.

When the counts have been reduced for all nine areas, it is planned to convert them to a common limiting magnitude by a carefully arranged program of sample recounting. It will then be possible to increase substantially the weights of the solutions for B by including in a single solution counts from more than one area. This program should result in significant determinations of the galactic extinction for different longitude intervals.

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RADIAL VELOCITY MEASUREMENTS OF SOME VISUAL DOUBLE STARS

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Abstract. The radial velocities of 48 visual double stars observed in 1952–1958 are listed in Table I.

Radial velocities of 48 visual double stars have been measured on 125 spectrograms obtained with the Coudé spectrograph of the 100-inch telescope of the Mount Wilson Observatory. One hundred twenty-one spectrograms were obtained between July, 1952, and June, 1954, two in 1957, and two in 1958. All spectrograms except those listed in the notes to Table I have a dispersion of 10 Å/mm.

The 20 star lines contained in Petrie's (1946) list of wavelength standards for high-dispersion spectrograms have been measured whenever possible. Broad star lines or poor quality of spectrograms occasionally reduced the number of lines measured.

Table I gives the radial velocities. The stars are listed by their ADS numbers, the brighter component first. When the brightnesses are equal, Aitken's designation is followed. Columns 2 and 3 list the spectral types and magnitudes,

TABLE I. RADIAL VELOCITIES OF SOME VISUAL DOUBLE STARS

Star	Spectral type	Mag.	Date	UT	Qual. of lines	Radial velocity (km/sec) S & Z		Wilson	Notes
ADS 683 A	gF0	6.3	1953 Nov. 26	2^h36^m	nn	+8.3	± 1.6	+5.0	65 Psc
B	gF0	6.3		3 20	nn	+4.6	1.6	+6.8	
903 A	dF5	6.8	Nov. 26	5 11	s	−8.6	0.6	−7.4	77 Psc
B	dF4	7.6		4 17	s	−6.9	0.4	−10	
3353 A	dF2	7.2	Nov. 25	10 00	s	+3.7	0.5	+4	
B	dF3	7.2		8 55	n	+15.9	1.7	+3.5	
4849 A	dF4	6.7	Nov. 26	11 44	s	+5.4	0.7	+6.8	
B	dF4	7.5		10 33	s	+7.4	0.4	+9	
5166 A	dF6	7.2	Nov. 25	12 45	s	+3.1	0.5	+0.4	20 Gem
B	dF6	8.1		11 26	nn	+5.0	2.5	+2	
6483 AB	dF6	6.4	Jan. 28	7 28	s	+4.7	0.3	−0.2	
6977 A	dF5	6.7	Mar. 27	3 15	s	−12.6	0.8	−18.2	
				7 03		−13.9	0.6		
B	dF6	7.5		5 03	s	−12.4	0.7	−17.8	
6988 A	dG6	4.2	Nov. 26	11 58	s	+16.5	0.4	+16.0	ι Cnc
7187 A	dF3	6.8	Mar. 31	7 08	s	+29.6	0.4	+29.1	
B	dF4	7.2		5 35	s	+29.0	0.4	+32.3	
7307 A	dF3	6.5	1954 Mar. 15	6 14	s	−4.9	0.4	+0.6	
B	dF2	6.8		6 59	s	−4.8	0.3	−1.9	
8119 A	dG0	4.4	1953 Jan. 28	8 40	s	−18.3	0.3	−15.5	ξ UMa
B	dG0	4.9		9 54	s	−14.2	0.3	−15.9	
8148 A	dF4	4.0	Jan. 30	10 32	s	−15.3	0.4	−10.3	ι Leo
8202 A	dF6	5.8	1954 May 15	3 52	s	+6.9	0.6	+4	17 Crt
B	dF7	5.9		4 59	s	+7.2	0.4	+9.8	
8257 A	(F5)	(7.05)	Mar. 14	7 08	nn	+2	8	—	
B	(F5)	(8.9)		9 06	s	+4.7	0.5	—	
8406 A	dA8	5.8	Mar. 13	10 31	n	+7.6	1.4	+4.8	2 Com
B	dF2	7.5		8 33	s	+8.6	0.7	+12.3	
8505 A	dF4	6.6	Mar. 16	6 00	s	−0.7	0.5	−1	
B	dF5	7.0		7 14	s	−1.4	0.4	+0.6	
8519 B	dF2	7.1	1953 Apr. 1	7 23	n	−19.1	0.8	−15	
8561 A	dF8	7.4	1954 Mar. 15	13 03	s	−2.0	0.7	−0.1	
B	dG2	8.0		12 08	s	−2.5	0.8	+1.3	
8627 A	dF6	6.0	1952 July 7	4 44	s	−10.2	0.5	−11.1	
8714 A	(F2p)	(8.0)	1954 Mar. 15	10 56	n	+9	2	—	
B	—	—		8 58	s	+4.3	1.0	—	
8786 A	dF5	7.2	Mar. 16	10 45	s	−88.3	0.6	−92.2	
			1957 Apr. 9	6 31		−90.7	0.7		
			1958 Mar. 4	10 16		−91.2	0.5		
B	dG0	7.6	1954 Mar. 16	9 11	s	−89.2	0.7	−86.5	
			1957 Jan. 18	12 17		−90.0	0.4		
			1958 Mar. 4	8 45		−90.4	0.6		
8883 A	(G5)	(7.35)	1954 May 20	4 15	s	+27.9	0.6	—	
B	(G5)	(7.65)		4 46	s	+27.8	0.7	—	
9053 A	dF7	6.5	May 19	4 40	n	−13.9	1.5	−19.0	
B	dG1	7.7		5 51	s	−15.3	0.4	−19.4	
9174 AB	F0+A2	6.8	1953 June 3	3 48	n	−7.2	1.0	−8.3	
9375 B	dF9	7.1	1954 May 18	4 56	s	−19.5	1.0	−19.9	54 Hya
9413 A	dG5	4.8	May 17	4 52	s	+2.8	0.4	+3.9	ξ Boo
				5 03		+1.7	0.5		
B	dK5	6.8		4 04	n	+3.5	0.7	+6	
9493 A	F0	7.1	1953 Mar. 27	8 44	n	−8.4	1.2	−8.4	
			Apr. 1	9 45		−2.6	1.4		
9507 A	dG5	7.3	1954 Mar. 14	12 11	s	−33.2	0.5	−34.5	
B	dG5	7.4		11 06	s	−37.2	0.6	−34.2	
9535 A	dG5	6.8	1953 Mar. 31	8 23	s	−39.6	0.5	−36.7	
B	dG6	7.6		9 30	s	−39.8	0.7	−40.1	
9580 A	dF5	6.7	1954 Mar. 13	13 15	s	−38.4	0.7	−45.5	
			May 17	5 46		−38.9	0.8		
B	—	—	Mar. 13	12 02	s	−35.2	0.5	—	
			May 17	6 49		−36.1	0.5		
9617 A	dF9	5.0	May 21	4 12	s	−9.1	0.4	−6.8	η CrB
				4 42		−8.0	0.6		
				4 47		−7.9	0.5		
B	—	—		4 35	s	−5.9	1.5	—	
AB				4 52		−8.3	0.5		
				4 58		−7.5	0.4		
9728 A	dF6	6.5	1952 July 7	5 50	s	−8.6	0.4	0	
			July 9	4 24		−7.8	0.4		
				5 21		−7.7	0.5		
			July 10	4 45		−7.3	0.6		

TABLE I (*continued*)

Star	Spectral type	Mag.	Date	UT	Qual. of lines	Radial velocity (km/sec) S & Z		Wilson	Notes
			1953 Apr. 2	9 38		− 1.5	0.8		
			Apr. 3	9 31		− 1.0	0.4		
			June 3	4 59		+ 1.4	0.6		
B	dF6	6.6	1952 July 7	6 54	s	+ 2.0	0.5	+ 3.5	
			July 9	4 55		+ 1.4	0.4		
			July 10	4 19		+ 0.9	0.6		
				5 10		+ 1.8	0.5		
			1953 Apr. 2	8 50		+ 1.4	1.0		
			Apr. 3	8 30		+ 2.2	0.4		
			June 3	4 48		− 0.2	0.4		
9969 A	dK0	7.5	1954 Mar. 16	11 48	s	+19.1	0.6	+18.1	49 Ser
B	dK1	7.6		12 50	s	+20.0	0.7	+20.8	
10157 A	dG0	3.0	1953 Aug. 19	4 15	s	−67.4	0.5	−69.9	ζ Her
				4 34		−67.8	0.6		
				4 41		−68.8	0.4		
			Aug. 22	3 42		−67.7	0.4		
				4 22		−68.4	0.3		
B	—	—	Aug. 19	3 52	s	−73.0	1.1	—	
			Aug. 22	4 22		−71.1	0.5		
				4 53		−70.4	0.4		
10993 B	gG3	5.2	Apr. 3	11 45	s	−33.0	0.6	−31.0	95 Her
11483 A	dG0	6.8	1952 July 8	7 35	s	+10.4	0.5	+ 9.6	
			July 9	9 42		+ 9.0	0.5		
B	dF8	7.2	July 8	8 36	s	+ 7.6	0.5	+ 2.1	
11639 A	dA9	4.3	1953 Aug. 19	6 05	s	+24.9	0.9	−26.0	ξ Lyr
12145 A	dG4	8.2	1952 July 9	8 38	s	+22.2	0.6	+28	
			1953 Aug. 20	5 12		+15.8	2.8		
BC	dK0	8.7	1952 July 9	7 30	s	+26.1	0.5	+24.8	
			1953 Aug. 20	4 00		+25.2	0.8		
12169 A	dG3	6.6	Aug. 20	7 07	s	−40.5	1.5	−37.6	
			Aug. 22	7 14		−40.9	0.9		
B	dG5	6.8	Aug. 20	6 18	s	−43.5	0.9	−41.1	
			Aug. 22	6 13		−42.4	0.7		
13868 A	dF6	6.6	Aug. 19	8 33	s	−12.6	0.5	−16.2	
B	—	—		7 11	s	−15.2	0.3	—	
14270 A	dG9	7.5	1952 July 10	9 58	s	−29.7	0.7	−25.6	
B	dG8	8.2		10 58	s	−31.6	0.7	−29.1	
14279 A	sgK1	4.5	1954 June 17	11 02	s	− 7.2	0.8	− 6.6	γ Del
B	dF6	5.5	June 18	11 00	s	− 6.2	0.7	− 7.6	
14636 A	dK6	5.6	1953 Aug. 19	11 39	s	−64.8	0.6	−64.3	61 Cyg
			Aug. 20	8 49		−64.2	1.1		
B	dM0	6.3	Aug. 19	10 07	s	−64.4	0.6	−63.5	
			Aug. 20	8 04		−65.5	1.6		
15971 A	dF2	4.4	Aug. 20	9 45	nn	+20.8	2.7	+24.9	ζ Aqr
B	dF1	4.6		10 52	n	+31.8	1.7	+28.9	
16417	dG1	6.5	1952 Dec. 7	4 14	s	−20.0	0.9	−26.5	
				5 02		−22.8	1.4		
16611 A	dF5	8.3	1953 Aug. 22	11 23	s	−29.4	0.7	−31.8	
B	dG2	9.7		9 55	s	−29.4	1.2	−24	
16979 A	A5	5.4	1952 July 9	11 38	nn	+10	4	− 1.8	107 Aqr
B	—	—	July 8	11 32	n	− 4.2	1.8	—	
17149 A	dG0	6.6	1953 Aug. 21	9 57	s	− 7.3	0.4	− 4.6	
			Aug. 22	8 46		− 6.9	0.6		
B	dG0	6.6		8 13	s	− 8.4	0.6	− 7.7	

NOTES

3353 B Spectroscopic binary. Poor spectrogram.

8119 A Spectroscopic binary. 5 Å/mm dispersion.

B Spectroscopic binary. 5 Å/mm dispersion.

8148 A 5 Å/mm dispersion.

8202 A 5 Å/mm dispersion.

B 5 Å/mm dispersion.

8627 A Spectroscopic binary; orbit Sanford, Karr.

9413 B H omitted from mean radial velocity.

9617 Spectroscopic binary; orbit Chang (1929). Radial velocity of A agrees well with Chang's velocity curve. Radial velocity of B is close to the γ-velocity, perhaps slightly contaminated by A.

9728 A Spectroscopic binary.

10157 Spectroscopic binary; orbit Berman (1941). Radial velocity of A agrees well with Berman's velocity curve. Using the mass ratio of $\mathfrak{M}_B/(\mathfrak{M}_A + \mathfrak{M}_B) = 0.39$, given by Berman, the radial velocity of B should be −72.6 km/sec; our observed value is −71.5 km/sec. The spectrogram of A taken at 3:42 UT, Aug. 22, has a dispersion of 2.8 Å/mm.

10993 B 5 Å/mm dispersion.

11639 A Spectroscopic binary; orbit Jordan.

12145 Spectrograms taken on August 20 are of poor quality, dark background. Wilson lists B, presumably the same as Aitken's BC.

14636 Spectrograms taken on August 20 are of poor quality, underexposed.

16147 Both spectrograms underexposed.

16611 B Spectroscopic binary.

respectively, from *The General Catalogue of Stellar Radial Velocities* by R. E. Wilson. For stars not listed by Wilson the spectral types and magnitudes from Aitken's double star catalogue are given in parentheses whenever available.

Three classifications from visual estimates are given for the quality of the absorption lines: s denotes sharp lines, n broad, nn very broad.

The velocities measured by us are listed together with the mean error for each spectrogram. No systematic corrections have been made, and the mean errors are only an indication of the internal consistency of measurements for each spectrogram, reflecting the quality of star lines and the quality of the spectrogram. The real accuracy of the radial velocities is probably considerably better than is indicated by the mean errors in the table. The latter are influenced to some extent by blends and inaccuracies of the adopted stellar wave length. The values $v_A - v_B$ should be especially accurate because in nearly all cases the two components of each double star were observed in immediate succession and with precisely the same adjustments of the spectrograph.

Table I also gives the radial velocities from Wilson's catalogue. The differences between our measurements and the catalogue values were investigated, excluding all known spectroscopic binaries and measured values of low weight. Means were used when more than one spectrogram of each star had been measured. The mean difference $v_{S\&Z} - v_{\text{Wilson}} = 0.0$ km/sec.

The last column of Table I gives the Greek letter or Flamsteed designation.

The average difference $|v_A - v_B|$ for all well-observed binaries, 29 in number, is 1.9 km/sec. Since the uncertainty of measurements given by the mean plate errors is approximately ±1.0 km/sec, we estimate that the difference 1.9−1.0, or about 1 km/sec, represents the average radial component of the relative orbital motion of the pairs included in this study. An attempt to group the values of $|v_A - v_B|$ according to the observed separations between the components corrected for their differences in distance from the sun gave the following results:

Separation in a.u.	Mean $\lvert v_A - v_B\rvert$	$\sqrt{\frac{(v_A - v_B)^2}{n}}$
0–250	2.3 km/sec	3.4 km/sec
250–2000	1.3	1.7

Only main sequence stars have been included in this comparison and their absolute magnitudes were taken from the H-R diagram as given by Allen (1955). The observed separations were corrected by the factor $(I_{\text{abs.}}/I_{\text{app.}})^{\frac{1}{2}}$, and the angular separations converted to astronomical units. There is perhaps a slight indication of a correlation between the separations and the values of $|v_A - v_B|$ or the root mean square differences of velocity, but the amount of material is not sufficient to regard this as established.

We express our thanks to Messrs. A. Weil and T. Henyey for many radial velocity measurements and reductions. A helpful suggestion by the referee has been included in the discussion. The spectrograms used in this investigation were obtained by Struve as guest investigator at the Mt. Wilson Observatory.

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THE SHORT-PERIOD VARIABLE, SX PHOENICIS

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Abstract. Two- and three-color observations of SX Phoenicis are described, and the possible existence of occasional rapid fluctuations is noted.

Jackson (1938, 1949) first called attention to the large proper motion of SX Phoenicis (HD 223065, CoD−42° 16457, CPD−42° 9607, GC 32998). The variation of light was announced by Eggen (1952). The star is an intrinsic variable with period approximately 80 minutes and range of light variation which has been observed to be as small as 0.3 mag. or as large as 0.8 mag.

From the trigonometric parallax and apparent magnitude Eggen computed the absolute magnitude to be +4.3; this falls within the range of possible values discussed by Jackson. The large proper motion and the high galactic latitude (−71°) also indicate that the star is relatively near and intrinsically faint. The fundamental data have been given by Evans, Menzies, and Stoy (1957). Kuiper (1940) described the star as a "probable subdwarf" (A3); Joy (1947) classified the spectrum as sd A2s. Walraven (1953, 1955) observed the star on 17 nights in one wavelength band and interpreted the light curve in terms of a beat-period phenomenon. O. Wilson and Walker (1956) observed the system spectroscopically and photoelectrically. On only one night were the photometric observations considered satisfactory; the radial velocity curve did not show the large variations in range found in the light curve.

The present study is based upon observations on three nights in 1957; on two of these the system was observed in three wavelength bands and on the other in two. The material is not sufficient in quantity to extend Walraven's analysis, but it is useful for a description of the light variation in three colors at this epoch. In addition to my own observations, I was able to study tracings made by A. H. Hogg and K. Gottlieb of the Mount Stromlo Observatory. These give an epoch of maximum of JD 243 5689.1181.

The observations are listed in Table I. Magnitude difference is in the natural system of the photometer. The observations were made with

TABLE I. PHOTOELECTRIC OBSERVATION OF SX PHE

JD (hel) 2436+	Comp. −Var.	JD (hel) 2436+	Comp. −Var.	JD (hel) 2436+	Comp. −Var.	JD (hel) 2436+	Comp. −Var.	JD (hel) 2436+	Comp. −Var.
				Yellow					
158.9507	$+1^{m}401$	175.9631	$+1^{m}664$	176.0149	$+1^{m}511$	183.9798	$+1^{m}407$	184.0198	$+1^{m}372$
.9548	1.335	.9637	1.679	.0195	1.704	.9898	1.988	.0306	1.346
.9651	1.393	.9697	1.708	.0202	1.724	.9905	2.013	.0326	1.436
.9675	1.418	.9782	1.599	.0244	1.863	.9991	1.736	.0393	1.649
.9725	1.558	.9823	1.509	.0286	1.823			.0451	1.817
.9823	1.763	.9862	1.479	.0454	1.392			.0461	1.802
.9860	1.726	.9968	1.309	.0507	1.355				
				.0554	1.317				
				Blue					
158.9520	$+1^{m}720$	175.9658	$+2^{m}143$	176.0068	$+1^{m}700$	183.9823	$+1^{m}871$	184.0010	$+2^{m}032$
.95569	1.652	.9664	2.152	.0098	1.799	.9831	1.911	.0017	2.014
.95583	1.628	.9709	2.113	.0109	1.819	.9839	1.951	.0216	1.691
.95597	1.602	.9718	2.088	.0163	1.974	.9929	2.434	.0341	1.852
.95611	1.645	.9735	2.123	.0169	2.009	.9941	2.377	.0350	1.881
.95625	1.632	.9802	1.982	.0221	2.225			.0417	2.066
.95639	1.656	.9808	1.972	.0260	2.348			.0424	2.090
.95653	1.667	.9834	1.923	.0264	2.325				
.95667	1.674	.9890	1.820	.0310	2.182				
.95681	1.674	.9883	1.719	.0476	1.804				
.95694	1.656			.0521	1.752				
.95708	1.632			.0564	1.713				
.95722	1.658			.0575	1.745				
.95736	1.674								
.95750	1.683								
.9665	1.762								
.9696	1.812								
.9703	1.836								
.9710	1.869								
.9738	1.952								
.9746	1.993								
.9841	2.212								
.9902	2.043								
				Ultraviolet					
		175.9682	$+2^{m}274$	176.0125	$+2^{m}091$	183.9862	$+2^{m}332$	184.0032	$+2^{m}063$
		.9745	2.223	.0180	2.239	.9868	2.387	.0038	2.033
		.9761	2.205	.0187	2.256	.9874	2.436	.0274	1.919
		.9813	2.099	.0233	2.333	.9971	2.275	.0366	2.072
		.9849	2.073	.0273	2.397				
		.9926	2.013	.0334	2.184				
				.0489	1.955				
				.0534	1.892				
				.0586	1.876				

the 20-inch Catts reflector of the Mount Stromlo Observatory and an EMI type 5060 multiplier photocell. The mechanical and optical parts of the photometer were conventional. The amplifier was constructed by Dr. W. M. Protheroe; a description will soon be published. Although it combines both direct-recording and integrating features, the rapidity of the light changes was such that only the direct-recording features were used. Glass color filters were ultraviolet Jena UG 2, 2mm (Schott); blue GE 13, 2mm +BG 12, 1mm (Schott); and yellow, Chance OY 4. The relations between this color system and the *U, B, V* system will shortly be published by B. Westerlund.

The comparison star was CoD–42° 16461, HD 223107 (G5). Its magnitude and color changes were linear with sec z; there is no reason to suspect it of variability.

The method of observing was to measure comparison star and sky in three wavelength bands (on the first night in two) and to observe the variable in each of the three alternately. Observations of the variable were then continued in alternate bands with frequent checks of the sky background. Normally, a measure in each band occupied one minute, but when rapid changes were occurring the star was occasionally followed continuously for as long as five minutes. After thus observing the variable for intervals which normally ran for twenty minutes the comparison star was again measured. In making the reductions, the intensity of the comparison star was found by interpolation to the time of each observation of the variable. When observation in one wavelength was carried on continuously for several minutes or showed appreciable change during the measure, the tracing was separated into two or more equal time intervals and each of these was reduced separately.

Periods. Dr. Th. Walraven has compared the observations with the ephemeris previously given by him (Walraven 1953); the results are shown in Table II. The first three columns give the observed maxima, the moments of mean light on the ascending branch computed by formula (2) in Walraven's paper, and the difference between these. The variation of the (O−C) was compared with that shown in Fig. 1 of his paper: a satisfactory agreement is obtained if the curve there shown is shifted to the left by 0.1 of the phase ψ. The fourth column lists the computed phase using the observed maxima and Walraven's formula (3). The values of $\Delta\phi$ in the fifth column are read from the curve using these phases corrected by 0.1. In the sixth column, these are reduced to days and in the seventh the residuals found by subtracting the sixth column from the third.

Walraven points out that in these observations maximum occurs 0^{d}0207 later than the ascending branches according to the 1952 observations, indicating the primary period has lengthened. By 1957 the beat phenomenon had shifted in phase so that the variations in phase and amplitude arrive about 0.1 beat-period earlier than in 1952. Thus the beat-period has shortened and this suggests that the period, P_0, has increased relatively more than the period P_1.

The light curve. The essential data of the light curve on each of the three nights are assembled in Table III. These were determined from study

TABLE II. PHASE OBSERVATIONS

Max. obs. JD 2436+	Asc. br. comp.	O−C days	ψ comp.	$\Delta\phi$ phase	$\Delta\phi$ days	Corr. O−C days
158.9819	.9630	+.0189	.252	−.026	−.0014	.0203
175.9674	.9469	+.0205	.334	−.005	−.0003	.0208
176.0257	.0019	+.0238	.636	+.038	+.0021	.0217
183.9910	.9717	+.0193	.942	−.020	−.0011	.0204
184.0447	.0267	+.0180	.225	−.030	−.0016	.0196

TABLE III. AMPLITUDE OBSERVATIONS

JD 2436000+	Yellow	Blue	Ultraviolet
158	0^{m}44 (0^{m}43–0^{m}47)	0^{m}58 (0^{m}58–0^{m}64)	
175–6	0^{m}40 (0^{m}40–0^{m}44) 0^{m}56 (0^{m}56–0^{m}60)	0^{m}45 (0^{m}45–0^{m}48) 0^{m}64 (0^{m}64–0^{m}68)	0^{m}28 (0^{m}27–0^{m}32) 0^{m}40 (0^{m}39–0^{m}44) (P) 0^{m}52 (0^{m}52–0^{m}56) (F)
183–4	0^{m}70 (0^{m}68–0^{m}72) 0^{m}50 (0^{m}48–0^{m}54)	0^{m}78 (0^{m}75–0^{m}79)	0^{m}60 (0^{m}55–0^{m}64)

(P) as measured from preceding min.
(F) as measured from following min.

f tracings, as well as plots of the listed observa- ions. Since it was not possible to observe simul- aneously in all colors, this method assumes that he maxima occur simultaneously in all colors. There is no evidence to the contrary but, because f the rapidity of the light changes, it would be ifficult to detect any lag unless it reached at east two minutes ($P_0/40$).

By each of the ranges are figures giving the stimated minimum and maximum values per- nitted by the observations. The range of light ariation in blue was larger than in the yellow lthough not always by the same amount. The ange in ultraviolet was the smallest of the three. n yellow and blue, the variation in range seems o be caused by fluctuations in the heights of naximum; minimum light (with possibly one xception) remains constant from cycle to cycle. n the ultraviolet, however, the brightness at ninimum varied by as much as 0.12 mag.

From the published observations of Wilson and Walker similar ranges were computed. The larger ange in yellow compared to ultraviolet is not hown in these observations. These were made t unavoidably large zenith distances, with sec z anging up to 6.5. No comparison star was used ecause the photometric observations were made imultaneously with the spectrographic ones. Because of these factors, it is not possible to onclude definitely that the system behaves ifferently in this respect at different epochs, lthough it seems likely that this is the case. The magnitudes at three minima reported by Wilson and Walker do not repeat precisely in he ultraviolet but do so in the longer wave- engths within normal observational error; this grees with the evidence discussed in the pre- eding paragraph.

It is difficult to derive a color curve in the sual manner, because of the rapidity of the olor changes. The colors listed in Table IV were bserved on December 3, 1957 when the longest ninterrupted run was made. They were com- uted by interpolating the yellow and ultra- iolet observations to the times of the blue, using nly cases where inspection of the light curve ndicated the light changes were linear. In a few ases the observations were extrapolated to the ime of the blue if they fell within two minutes f it. The colors were then reduced to outside he atmosphere using coefficients determined from bservations of the companion star. Second-order ffects caused by color differences of comparison nd variable were ignored. The maximum zenith

TABLE IV. OBSERVED COLORS

Phase	$B-Y$	$UV-B$	Phase	$B-Y$	$UV-B$
$0^d.0551$	$+^m.667$	-1.446	$0^d.0495$	$+^m.670$	-1.422
.0035	+.677	−1.422	.0547	+.708	−1.528
.0131	+.642	−1.433	.0000	+.714	−1.526
.0160	+.657	−1.438	.0050	+.642	−1.508
.0216	+.668	−1.357	.0219	+.624	−1.389
.0489	+.662	−1.404	.0264	+.690	−1.362

distance for which colors were computed was 48°. The phases in Table III are from the preceding maximum. A plot of $B-Y$ against $UV-B$ was made to search for evidence of a loop-wise pro- gression with phase such as found by Hardie and Geilker (1958) in RR Lyrae and by Tifft and Smith (1958) in T Sextantis. Color changes from cycle to cycle make it impossible to confirm the existence of such a loop on the basis of the present evidence.

Finally, Figure 1 reproduces a portion of the recordings taken on the first night of observation. The tracing showing the fluctuation in the blue intensity between $8^h54^m.0$ and $8^h56^m.8$ Stromlo time is difficult to interpret. The natural sus- picion is to blame this on varying transparency in the earth's atmosphere. However, fluctuations caused by poor sky usually (although not always) give more erratic traces than this; moreover, when changes of this amplitude are seen on the tracings, it has been my experience that careful

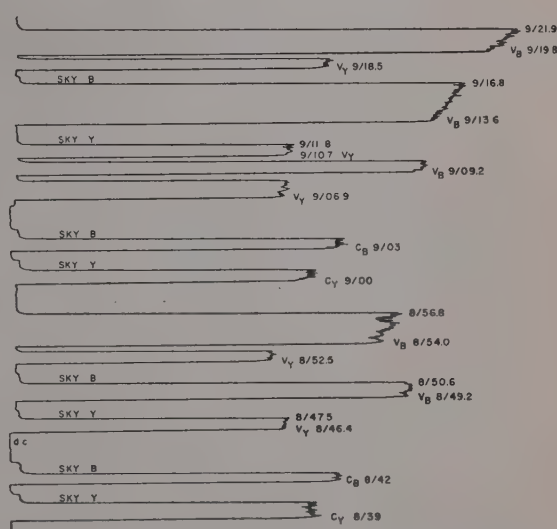

Figure 1. Possible fluctuations in SX Phe, blue light. The fluctuations between 8/54.0 and 8/56.8 are difficult to interpret. In the blue observation following the last shown, the pen was pinned at the top of the chart; reduced gain was needed to make the measure.

inspection of the sky shows signs of trouble; such was not the case. The star was carefully centered in the diaphragm at the beginning of the observation and was still centered at the end; no trouble with the telescope drive occurred during the night. Nevertheless, it must be granted that in the case of a normal star, such a tracing probably would not even be reduced. It is shown here partly because the changes are at the same rate as those shown 20 minutes later when the light was increasing most rapidly. It may be pertinent to note that the star averaged 0.1 mag. fainter at this time than at the other minima in this color. Certainly further observations should pay particular attention to the star at this part of the curve. In the listed observations, the tracing was subdivided into time intervals of 0.2 minute and the relative difference of magnitude was computed for each.

As in so many cases, the chief conclusion is that further observations are needed. It is important to observe in the ultraviolet, as well as in other colors; simultaneous observation with two or more telescopes would be particularly helpful.

I am indebted to Drs. Th. Walraven and H. J. Smith for criticism of the first draft typescript and to Drs. A. R. Hogg and B. Westerlund for sending information concerning the equipment. I am especially grateful to the staff at Mount Stromlo for yielding telescope time and for efficient aid in installing the photometer and in keeping the telescope in operation. The work was made possible by the combination of a sabbatical leave and a Fulbright award. The electronic parts of the photometer were constructed by Dr. W. M. Protheroe with the aid of a special research grant from the University of Pennsylvania.

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SOME PERIODIC ORBITS IN THE RESTRICTED PROBLEM OF THREE BODIES AND THEIR STABILITIES

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Abstract. Periodic orbits in the restricted problem of three bodies near the exterior case of 2:1 commensurability of period have been found by step-by-step numerical integration, using the IBM 650 computer at the Yale University Computing Center. Periodic orbits with eccentricities up to 0.4 have been traced on the two series of symmetric orbits and also on one of the series of asymmetric orbits, and on one series of symmetric orbits members were traced with eccentricities up to 0.9. For the orbits of all but the largest eccentricities the coordinates are exhibited as Fourier series. The ordinary stabilities of a selection of the orbits of eccentricities up to 0.1 were investigated using a method deriving from Brown's method for the determination of the motion of the lunar perigee. The symmetric orbits of small eccentricity prove to be stable, those of larger eccentricity unstable, and the asymmetric orbits investigated are stable, there being an exchange of stability at the point of bifurcation.

In a paper (Message 1958) presented to the Symposium on Celestial Mechanics held in New York in March 1958 I described how an investigation based on the secular and critical terms of the disturbing function in cases of near-commensurability of period led to the conclusion that there are, in certain of the exterior cases of commensurability, periodic solutions of the restricted problem of three bodies which are asymmetric, as well as those which are symmetric and which have been studied by many writers (Poincaré 1892; Darwin 1898, 1909, 1912; Hill 1902; Schwarzschild 1903; van Veen 1927). I also described the beginning of a project to illustrate these periodic orbits and investigate their properties further by tracing examples by step-by-step numerical integration, using the IBM 650 computer of the Yale University Computing

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enter. The aim of the present paper is to describe some periodic orbits which have been traced, belonging to three series of orbits in the :1 exterior commensurability case, two consisting of symmetric orbits and the third of asymmetric; and to investigate the stability of a selection of these orbits.

In the restricted problem of three bodies as usually defined, the system considered consists of a central body S of mass M, a body J of mass Mm' moving about S in a circular orbit of radius a', and a body P of negligible mass moving in the field of both. The system is referred to rectangular axes with origin O at the center of mass of S and J, the axes rotating about the normal to the orbit plane of J with angular velocity n', the angular velocity of J in its orbit, so that the axis OX may be chosen so that S and J are both always on it, their coordinates being $\{-\alpha'm'/(1+m'), 0, 0\}$ and $\{\alpha'/(1+m'), 0, 0\}$, respectively. The coordinates (x, y, z) of P are governed by the equations of motion

$$\begin{aligned}
\frac{d^2x}{dt^2} - 2n'\frac{dy}{dt} - n'^2x &= -\frac{\mu}{r_S^3}\left(x + \frac{\alpha'm'}{1+m'}\right) - \frac{\mu m'}{r_J^3}\left(x - \frac{\alpha'}{1+m'}\right) \\
\frac{d^2y}{dt^2} + 2n'\frac{dx}{dt} - n'^2y &= -\frac{\mu}{r_S^3}\cdot y - \frac{\mu m'}{r_J^3}\cdot y \\
\frac{d^2z}{dt^2} &= -\frac{\mu z}{r_S^3} - \frac{\mu m' z}{r_J^3},
\end{aligned} \tag{1}$$

where

$$\mu = GM,$$

$$r_S^2 = \left(x + \frac{\alpha'm'}{1+m'}\right)^2 + y^2,$$

$$r_J^2 = \left(x - \frac{\alpha'}{1+m'}\right)^2 + y^2;$$

G being the constant of gravitation. The orbits traced all lie in the orbit plane of J, and so z is always zero. The first two equations were integrated by the central difference method described in the previous paper.

A periodic orbit, in the sense usual in this context, is one in which the perturbations in the orbital elements are periodic functions of the time, the period (T, say) being equal to the synodic period of P and J. Since the coordinates of P are referred to a frame rotating with J, they too are periodic functions with this period. In the commensurability case at present under discussion the mean motions n and n' of P and J, respectively, are related by

$$2n - n' = \sigma n, \tag{2}$$

where $|\sigma|$ is small compared to unity. Thus the orbit of P lies outside that of J, and in the rotating frame the mean motion of P is retrograde. Consequently near conjunction of P with J the coordinate y will pass from positive to negative values. The integration of each orbit was begun at the point where the mean longitudes λ and λ' of P and J, respectively, are equal. The data supplied to the computer included the osculating values of the eccentricity (e_0) and the ratio of the semi-major axes of the orbits of P and J (α_0/α'), the initial value of the mean anomaly ($\lambda_0 - \varpi_0$), and the size of the step of integration. The value of the mass ratio m' employed was 0.000 954 927, as used by K. Schwarzschild (1903) for the mass of Jupiter. The program was designed to stop the integration a few steps after y began to take negative values for the second time. Interpolation by Neville's process (1934) was carried out to find the values of x, dx/dt, dy/dt, and λ' corresponding to the point in the orbit where y regains its initial value. If the orbit is precisely periodic x, dx/dt, and dy/dt also will have returned to their initial values. A search process of trial integrations followed by interpolation of residuals was carried out to find sets of data leading to orbits in which x/α', y/α', $(dx/dt)/\alpha'n'$ and $(dy/dt)/\alpha'n'$ simultaneously return to their original values to within five decimal places. The symmetric orbits meet the axis $y = 0$ at right angles at the end of each half period, and so the search for an orbit of this type only requires the integration of the first half of the orbit, periodic orbits being identified by this property. The accuracy of the integration was checked by evaluating the constant k in Jacobi's integral

$$\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 - n'^2(x^2+y^2) - \frac{2\mu}{r_S} - \frac{2\mu m'}{r_J} = k, \tag{3}$$

using the coordinates and velocities at different points on the orbit, and the step of integration was chosen to maintain k constant to six significant figures throughout the integration, some of the orbits with large eccentricities being integrated in more than one stage with different sized steps.

The investigation of the secular and critical terms near this commensurability, which considered eccentricities up to 0.15, showed the existence of four series of periodic orbits, two of them of symmetric orbits and two of asymmetric. In all of them the critical argument

$$\theta = 2\lambda - \lambda' - \varpi$$

is constant, apart from terms of short period. In one of the series of symmetric orbits this constant value of θ is 0, in the other it is π, and there is a member of each of these two series corresponding to each value of the mean eccentricity. The relation between α/α' and the mean eccentricity on each series derived from these terms was used to give approximate osculating values of α/α' for each osculating value (e_0) of the eccentricity at conjunction, from which the search process was begun. For higher values of e_0 on each series the search was commenced with values of α/α' extrapolated from those found for smaller e_0. Members of the series $\theta = \pi$ were traced with e_0 ranging from 0.0125 to 0.90. Some of these are shown in the accompanying diagrams, points corresponding to equally spaced instants of time being represented by filled circles. On the orbits with $e_0 = 0.40$ and larger the angular velocity, relative to a fixed frame, at pericenter is greater than n', and so relative to the rotating frame P has a direct motion, so that in this frame the orbit has a loop, which is larger for greater values of the eccentricity. (In the orbit with $e_0 = 0.40$, alternate points on the loop have been omitted from the diagram for clarity.) Members of the series $\theta = 0$ were traced with e_0 ranging from 0.0125 to 0.40, some of them being shown on the accompanying diagrams, points on these orbits being represented by crosses. (In the orbit with $e_0 = 0.40$, two out of every three points on the loop are omitted for clarity.)

The two series of asymmetric orbits branch from the series $\theta = \pi$ at $e = 0.0367$; on one series θ is smaller for larger values of e, and on the other it is larger, the two values of θ for a given e having the sum 2π. From this last property it can be seen by considering the expressions for the coordinates as Fourier series in the two arguments θ and $\lambda - \lambda'$ that each of the two asymmetric orbits corresponding to a given value of e is the mirror image of the other in the line $y = 0$, and so only one of these series was investigated. Members were found for values of e_0 between 0.0375 and 0.40, some of them being shown on the diagrams, points being indicated by open circles. (In the orbit with $e_0 = 0.40$ alternate points on the loop have been omitted for clarity.) Tables I to III give, for all the orbits traced, the osculating values at conjunction of θ, e_0, and α/α', the period, T, in terms of that of J, the quantity σ measuring the closeness of the commensurability of period, and Jacobi's constant k.

Since the coordinates and velocities relative to the rotating frame are periodic functions of time with period T, they may be expressed as Fourier

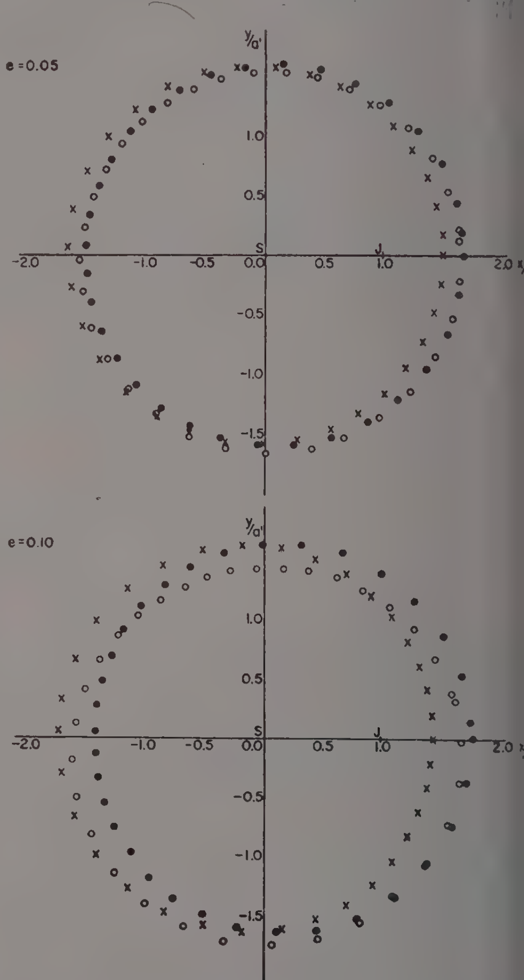

Figure 1. Points corresponding to equally spaced instants of time in periodic orbits are indicated: by filled circles for symmetric orbits of the series $\theta = \pi$, by crosses for symmetric orbits of the series $\theta = 0$, by open circles for asymmetric orbits.

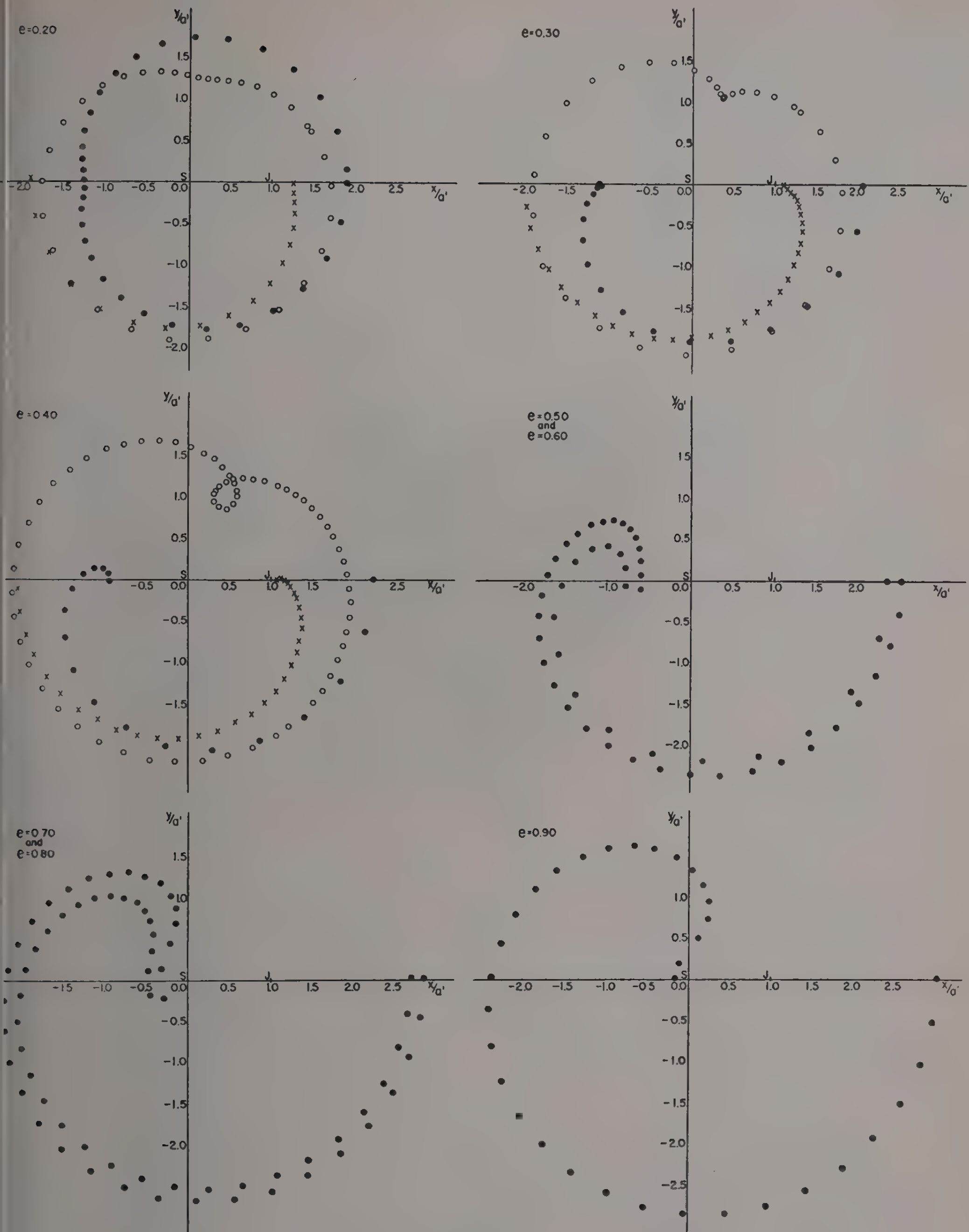

Figure 1. (*continued*)

TABLE I. SERIES $\theta = \pi$

e_0	a_0/a'	T/T'	σ	$k/n'^2a'^2$
0.0125	1.603293	1.980954	−0.019416	−3.15410
0.025	1.597200	1.992249	−0.007812	−3.15098
0.0375	1.595056	1.996395	−0.003618	−3.14903
0.05	1.593950	1.998587	−0.001415	−3.14709
0.10	1.592730	2.001266	0.001265	−3.13667
0.15	1.592520	2.001747	0.001744	−3.12029
0.20	1.592458	2.001722	0.001719	−3.09749
0.25	1.592386	2.001541	0.001539	−3.06801
0.30	1.592267	2.001290	0.001289	−3.03158
0.40	1.591878	2.000843	0.000842	−2.93651
0.50	1.591337	2.000425	0.000425	−2.80853
0.60	1.590694	2.000054	0.000054	−2.64144
0.70	1.590002	1.999918	−0.000082	−2.42443
0.80	1.589334	1.999713	−0.000287	−2.13627
0.90	1.588691	1.999857	−0.000143	−1.72233

TABLE II. SERIES $\theta = 0$

e_0	a_0/a'	T/T'	σ	$k/n'^2a'^2$
0.0125	1.567251	2.049331	0.047012	−3.14039
0.025	1.578107	2.027381	0.026651	−3.14414
0.05	1.582210	2.018634	0.018293	−3.14372
0.10	1.582021	2.016625	0.016354	−3.13505
0.20	1.571565	2.027216	0.026495	−3.09613
0.30	1.572116	2.100643	0.091440	−3.04340
0.40	1.781873	2.122834	0.109396	−3.03192

TABLE III. ASYMMETRIC SERIES

e_0	a_0/a'	T/T'	σ	$k/n'^2a'^2$	$\theta_0/2\pi$
0.0375	1.595500	1.995546	−0.004474	−3.14923	0.4250
0.05	1.595583	1.995517	−0.004503	−3.14787	0.3578
0.10	1.595884	1.995702	−0.004317	−3.13843	0.2790
0.15	1.596251	1.995968	−0.004051	−3.12259	0.2461
0.20	1.596523	1.99634	−0.00368	−3.10018	0.2243
0.25	1.596600	1.99681	−0.00320	−3.07101	0.2074
0.30	1.596398	1.99732	−0.00268	−3.03479	0.1953
0.40	1.595265	1.99851	−0.00149	−2.93994	0.1813

TABLE IV. ORBITS WITH $\theta = \pi$; REPRESENTATION OF x AND y BY $x = \Sigma a_j \cos ju$; $y = \Sigma b_j \sin ju$

j	a_j ($e_0 = 0.0125$)	b_j ($e_0 = 0.0125$)	a_j ($e_0 = 0.025$)	b_j ($e_0 = 0.025$)	a_j ($e_0 = 0.0375$)	b_j ($e_0 = 0.0375$)
0	−0.01126		−0.02130		−0.031361	
1	+1.59773	−1.59771	+1.59149	−1.59085	+1.589103	−1.587454
2	+0.03455	−0.03456	+0.06455	−0.06457	+0.094620	−0.094680
3	+0.00103	−0.00102	+0.00111	−0.00111	+0.001238	−0.001234
4	+0.00021	−0.00021	+0.00021	−0.00021	+0.000202	−0.000201
5	+0.00007	−0.00007	+0.00007	−0.00007	+0.000067	−0.000066
6	+0.00003	−0.00003	+0.00003	−0.00003	+0.000026	−0.000026
7	+0.00001	−0.00001	+0.00001	−0.00001	+0.000011	−0.000011
8					+0.000005	−0.000005
9					+0.000003	−0.000003
10					+0.000001	−0.000001

j	a_j ($e_0 = 0.05$)	b_j ($e_0 = 0.05$)	a_j ($e_0 = 0.10$)	b_j ($e_0 = 0.10$)	a_j ($e_0 = 0.15$)	b_j ($e_0 = 0.15$)
0	−0.04141		−0.08108		−0.119671	
1	+1.58770	−1.58466	+1.58468	−1.57234	+1.581610	−1.554355
2	+0.12469	−0.12483	+0.24442	−0.24553	+0.363032	−0.366707
3	+0.00142	−0.00141	+0.00286	−0.00274	+0.005519	−0.004971
4	+0.00019	−0.00019	+0.00009	−0.00010	−0.000144	+0.000059
5	+0.00006	−0.00006	+0.00006	−0.00005	+0.000070	−0.000055
6	+0.00002	−0.00002	+0.00002	−0.00002	+0.000013	−0.000015
7	+0.00001	−0.00001	+0.00001	−0.00001	+0.000008	−0.000007
8					+0.000003	−0.000003
9					+0.000002	−0.000001
10					+0.000001	−0.000001

j	a_j ($e_0 = 0.20$)	b_j ($e_0 = 0.20$)	a_j ($e_0 = 0.25$)	b_j ($e_0 = 0.25$)	a_j ($e_0 = 0.30$)	b_j ($e_0 = 0.30$)
0	−0.156754		−0.191935		−0.22482	
1	+1.577374	−1.530065	+1.571465	−1.499623	+1.56344	−1.46337
2	+0.480251	−0.488704	+0.595881	−0.611805	+0.70980	−0.73618
3	+0.009597	−0.007933	+0.015327	−0.011445	+0.02296	−0.01532
4	−0.000619	+0.000273	−0.001498	+0.000496	−0.00299	+0.00064
5	+0.000137	−0.000061	+0.000320	−0.000050	+0.00072	+0.00003
6	−0.000004	−0.000013	−0.000054	+0.000021	−0.00018	−0.00007
7	+0.000009	−0.000005	+0.000021	+0.000000	+0.00006	+0.00002
8	+0.000002	−0.000003	−0.000002	−0.000004	−0.00002	−0.00001
9	+0.000001	−0.000001	+0.000002		+0.00001	
10	+0.000001	−0.000001				

TABLE IV (*Continued*)

a_j ($e_0 = 0.40$)	b_j ($e_0 = 0.40$)	a_j ($e_0 = 0.50$)	b_j ($e_0 = 0.50$)
−0.28224		−0.32616	
+1.53895	−1.37501	+1.49931	−1.26871
+0.93261	−0.98902	+1.14980	−1.24640
+0.04504	−0.02371	+0.07748	−0.03301
−0.00877	+0.00021	−0.01991	−0.00182
+0.00282	+0.00076	+0.00804	+0.00304
−0.00105	−0.00050	−0.00375	−0.00206
+0.00043	+0.00025	+0.00190	+0.00123
−0.00018	−0.00012	−0.00100	−0.00072
+0.00008	+0.00006	+0.00054	+0.00041
−0.00004	−0.00003	−0.00030	−0.00024
+0.00002	+0.00001	+0.00017	+0.00014
−0.00001	−0.00001	−0.00010	−0.00008
		+0.00006	+0.00004
		−0.00004	−0.00002
		+0.00004	

a_j ($e_0 = 0.60$)	b_j ($e_0 = 0.60$)	a_j ($e_0 = 0.70$)	b_j ($e_0 = 0.70$)
−0.3539		−0.3630	
+1.4388	−1.1481	+1.3505	−1.0161
+1.3643	−1.5058	+1.5804	−1.7631
+0.1210	−0.0453	+0.1755	−0.0659
−0.0378	−0.0052	−0.0624	−0.0076
+0.0180	+0.0075	+0.0334	+0.0131
−0.0099	−0.0057	−0.0206	−0.0113
+0.0058	+0.0039	+0.0136	+0.0087
−0.0036	−0.0026	−0.0093	−0.0066
+0.0022	+0.0017	+0.0066	+0.0050
−0.0014	−0.0012	−0.0048	−0.0037
+0.0009	+0.0008	+0.0035	+0.0028
−0.0006	−0.0005	−0.0026	−0.0021
+0.0004	+0.0004	+0.0020	+0.0016
−0.0003	−0.0002	−0.0015	−0.0012
+0.0002	+0.0002	+0.0012	+0.0009
−0.0001	−0.0001	−0.0009	−0.0007
+0.0001	+0.0001	+0.0007	+0.0005
−0.0001		−0.0006	−0.0003
+0.0001		+0.0005	+0.0002
		−0.0005	−0.0001
		+0.0005	

eries with argument

$$u = \frac{2\pi}{T}(t - t_0), \tag{4}$$

here t_0 is the time of conjunction, so that u is ie uniform part of $\lambda' - \lambda$. A program was de- ised to carry out Fourier analysis of these quan- ties, which, reading the values at successive eps of integration from the output cards from ie integration of the equations of motion, deter- iined the values of x, y, dx/dt and dy/dt at N qually spaced values of u in the range $0 \leq u < 2\pi$, y interpolation using Neville's process. The ourier analysis was then carried out on those alues. N was given the value 30 for most of the rbits analyzed and 20 for those with the smaller alues of e_0. The Fourier series found for the oordinates are given in Tables IV to VI.

The stability of the orbits. In order to investigate the ordinary linear stability of a selection of the orbits obtained by numerical integration, an appropriate form of Hill's equation was derived, as follows. The equations of motion in the plane $z = 0$ may be written, from Eq (1) in the form

$$\begin{aligned} \frac{d^2x}{dt^2} - 2n'\frac{dy}{dt} &= \frac{\partial\Omega}{\partial x} \\ \frac{d^2y}{dt^2} + 2n'\frac{dx}{dt} &= \frac{\partial\Omega}{\partial y}, \end{aligned} \tag{5}$$

where

$$\Omega = \frac{\mu}{r_S} + \frac{\mu m'}{r_J} + n'^2(x^2 + y^2)$$

and Jacobi's integral is then

$$\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 = 2\Omega + C, \tag{6}$$

where C is constant. If $x = x_0(t)$, $y = y_0(t)$ is a known periodic solution of these equations, consider a solution $x = x_0 + \Delta x$, $y = y_0 + \Delta y$, where Δx and Δy are supposed initially small. Then, neglecting squares and products of these small quantities, the Eqs. (5) give

$$\begin{aligned} &\frac{d^2}{dt^2}(\Delta x) - 2n'\frac{d}{dt}(\Delta y) \\ &\qquad = \left(\frac{\partial^2\Omega}{\partial x^2}\right)_0 \Delta x + \left(\frac{\partial^2\Omega}{\partial y \partial x}\right)_0 \Delta y \\ &\frac{d^2}{dt^2}(\Delta y) + 2n'\frac{d}{dt}(\Delta x) \\ &\qquad = \left(\frac{\partial^2\Omega}{\partial x \partial y}\right)_0 \Delta x + \left(\frac{\partial^2\Omega}{\partial y^2}\right)_0 \Delta y, \end{aligned} \tag{7}$$

where the suffix "0" applied to a function means that it is evaluated for $x = x_0$, $y = y_0$, and $z = 0$. From Jacobi's integral, taking $\Delta C = 0$ (which does not lose generality since the solution x_0, y_0 may be chosen appropriately from the series),

$$\begin{aligned} &\frac{dx_0}{dt}\cdot\frac{d}{dt}(\Delta x) + \frac{dy_0}{dt}\cdot\frac{d}{dt}(\Delta y) \\ &\qquad = \left(\frac{d^2x_0}{dt^2} - 2n'\frac{dy_0}{dt}\right)\Delta x \\ &\qquad\quad + \left(\frac{d^2y_0}{dt^2} + 2n'\frac{dx_0}{dt}\right)\Delta y. \end{aligned} \tag{8}$$

TABLE V. ORBITS WITH $\theta = 0$; REPRESENTATION OF x AND y BY $x = \Sigma a_j \cos ju$; $y = \Sigma b_j \sin ju$

j	a_j	b_j	a_j	b_j	a_j	b_j
	$e_0 = 0.0125$		$e_0 = 0.025$		$e_0 = 0.05$	
0	0.00958		0.01963		0.04001	
1	+1.56246	−1.56268	+1.57323	−1.57289	+1.57732	−1.57472
2	−0.02731	+0.02727	−0.05722	+0.05719	−0.11787	+0.11793
3	+0.00149	−0.00150	+0.00157	−0.00158	+0.00213	−0.00214
4	+0.00031	−0.00031	+0.00031	−0.00031	+0.00035	−0.00035
5	+0.00010	−0.00010	+0.00010	−0.00010	+0.00012	−0.00011
6	+0.00004	−0.00004	+0.00004	−0.00004	+0.00005	−0.00005
7	+0.00002	−0.00002	+0.00002	−0.00002	+0.00002	−0.00002
8	+0.00001	−0.00001	+0.00001	−0.00001	+0.00001	−0.00001
9			+0.00001		+0.00001	

j	a_j	b_j	a_j	b_j	a_j	b_j
	$e_0 = 0.10$		$e_0 = 0.20$		$e_0 = 0.30$	
0	0.08091		0.16365		0.25596	
1	+1.57678	−1.56499	+1.56404	−1.51419	+1.51352	−1.39364
2	−0.23995	+0.24090	−0.48925	+0.49801	−0.73831	+0.77010
3	+0.00433	−0.00425	+0.01521	−0.01357	+0.05576	−0.04665
4	+0.00052	−0.00052	+0.00185	−0.00153	+0.00870	−0.00590
5	+0.00016	−0.00016	+0.00048	−0.00041	+0.00246	−0.00152
6	+0.00006	−0.00006	+0.00017	−0.00016	+0.00086	−0.00051
7	+0.00003	−0.00003	+0.00007	−0.00007	+0.00034	−0.00019
8	+0.00001	−0.00001	+0.00003	−0.00003	+0.00014	−0.00007
9	+0.00001	−0.00001	+0.00002	−0.00002	+0.00006	−0.00002
10			+0.00001	−0.00001	+0.00003	−0.00001
11					+0.00001	
12					+0.00001	

TABLE VI. ASYMMETRIC SERIES

$x = \Sigma a_j \cos ju + \Sigma b_j \sin ju \qquad y = \Sigma a_j' \cos ju + \Sigma b_j' \sin ju$

j	a_j	b_j	a_j'	b_j'	a_j	b_j	a_j'	b_j'
	$e_0 = 0.0375$				$e_0 = 0.05$			
0	−0.02810		+0.01326		−0.02654		0.03034	
1	+1.58923	+0.00156	+0.00016	−1.58828	+1.58761	+0.00341	+0.00039	−1.58824
2	+0.08485	+0.04007	+0.04012	−0.08486	+0.08010	+0.09176	+0.09182	−0.07998
3	+0.00113	+0.00030	+0.00030	−0.00113	+0.00085	+0.00066	+0.00066	−0.00085
4	+0.00021	+0.00002	+0.00002	−0.00020	+0.00021	+0.00005	+0.00005	−0.00021
5	+0.00007	+0.00001	+0.00001	−0.00007	+0.00006	+0.00002	+0.00002	−0.00006
6	+0.00003			−0.00003	+0.00002	+0.00001	+0.00001	−0.00002
7	+0.00001			−0.00001	+0.00001			−0.00001
8	+0.00001			−0.00001				
	$e_0 = 0.10$				$e_0 = 0.15$			
0	−0.01662		0.07636		−0.00027		0.11571	
1	+1.57665	+0.00686	+0.00216	−1.58741	+1.55931	+0.00625	+0.00635	−1.58507
2	+0.04956	+0.23244	+0.23158	−0.04896	−0.00190	+0.35601	+0.35261	+0.00185
3	−0.00094	+0.00113	+0.00120	+0.00101	−0.00349	+0.00047	+0.00046	+0.00398
4	+0.00020	+0.00017	+0.00018	−0.00020	+0.00010	+0.00034	+0.00042	−0.00010
5	+0.00005	+0.00004	+0.00004	−0.00005	+0.00004	+0.00006	+0.00006	−0.00005
6	+0.00002	+0.00002	+0.00002	−0.00002		+0.00002	+0.00002	
7	+0.00001	+0.00001	+0.00001	−0.00001		+0.00001	+0.00001	
	$e_0 = 0.20$				$e_0 = 0.25$			
0	0.02081		0.15086		0.04548		0.18177	
1	+1.53675	+0.00113	+0.01358	−1.57989	+1.51018	−0.00861	+0.02409	−1.57053
2	−0.07045	+0.47081	+0.46366	+0.06720	−0.15412	+0.57720	+0.56627	+0.14397
3	−0.00642	−0.00126	−0.00208	+0.00769	−0.00960	−0.00396	−0.00696	+0.01152
4	−0.00008	+0.00053	+0.00076	+0.00028	−0.00029	+0.00077	+0.00105	+0.00115
5	+0.00003	+0.00007	+0.00012	−0.00007	+0.00004	+0.00005	+0.00029	−0.00006
6	−0.00001	+0.00002	+0.00001		−0.00002		−0.00001	−0.00004
7	−0.00001	+0.00001	+0.00001		−0.00001			
	$e_0 = 0.30$							
0	0.0702		0.2091					
1	+1.4800	−0.0218	+0.0368	−1.5565				
2	−0.2430	+0.6778	+0.6639	+0.2222				
3	−0.0132	−0.0072	−0.0141	+0.0150				
4	−0.0005	+0.0012	+0.0010	+0.0026				
5	+0.0002	+0.0000	+0.0006	+0.0001				
6		−0.0001	+0.0001	−0.0001				

ut

$$\frac{dx_0}{dt} = V\cos\psi, \quad \frac{dy_0}{dt} = V\sin\psi, \qquad (9)$$

nd

$$p = \Delta x\cos\psi + \Delta y\sin\psi$$
$$q = -\Delta x\sin\psi + \Delta y\sin\psi. \qquad (10)$$

hen p and q are respectively the tangential and ormal displacements from the periodic orbit. liminating Δx and Δy in favor of p and q in qs. (7), using (8), gives

$$\frac{d}{dt}\left(\frac{p}{V}\right) = 2\left(n' + \frac{d\psi}{dt}\right)\frac{q}{V} \qquad (11)$$

nd

$$\frac{d^2q}{dt^2} + f(t)\cdot q = 0, \qquad (12)$$

here

$$(t) = 4n'^2 + 6n'\frac{d\psi}{dt} + 3\left(\frac{d\psi}{dt}\right)^2 - \left(\frac{\partial^2\Omega}{\partial x^2}\right)_0 \sin^2\psi$$
$$+ 2\left(\frac{\partial^2\Omega}{\partial x\partial y}\right)_0 \sin\psi\cos\psi - \left(\frac{\partial^2\Omega}{\partial y^2}\right)_0 \cos^2\psi.$$

q. (12) is Hill's equation. Now in the case of 10se orbits for which we have the coordinates s Fourier series, their higher derivatives with espect to the time are more readily obtained 1an are the partial derivatives of Ω. Differen- ating Eq. (5) with respect to the time we see 1at

$$\frac{x_0}{t^3} - 2n'\frac{d^2y_0}{dt^2} = \left(\frac{\partial^2\Omega}{\partial x^2}\right)_0 \frac{dx_0}{dt} + \left(\frac{\partial^2\Omega}{\partial y\partial x}\right)_0 \frac{dy_0}{dt}$$
$$(13)$$
$$\frac{y_0}{t^3} + 2n'\frac{d^2x_0}{dt^2} = \left(\frac{\partial^2\Omega}{\partial x\partial y}\right)_0 \frac{dx_0}{dt} + \left(\frac{\partial^2\Omega}{\partial y^2}\right)_0 \frac{dy_0}{dt},$$

1d since

$$\frac{\partial^2\Omega}{\partial x^2} + \frac{\partial^2\Omega}{\partial y^2} + \frac{\partial^2\Omega}{\partial z^2} = 2n'^2,$$

e have

$$(t) = 2n'^2 + 4n'\frac{d\psi}{dt} + 3\left(\frac{d\psi}{dt}\right)^2 + X + \left(\frac{\partial^2\Omega}{\partial z^2}\right)_0,$$

here

$$V^2X = \frac{dx_0}{dt}\frac{d^3x_0}{dt^3} + \frac{dy_0}{dt}\frac{d^3y_0}{dt^3}.$$

Now

$$\left(\frac{\partial^2\Omega}{\partial z^2}\right)_0 = -\left(\frac{\mu}{r_S^3}\right)_0 - \left(\frac{\mu m'}{r_J^3}\right)_0$$
$$= \frac{1}{y_0}\left(\frac{d^2y_0}{dt^2} + 2n'\frac{dx_0}{dt} - n'^2y_0\right),$$

and so, putting

$$y_0Y = \frac{d^2y_0}{dt^2} + 2n'\frac{dx_0}{dt},$$

we have

$$f(t) = n'^2 + 4n'\frac{d\psi}{dt} + 3\left(\frac{d\psi}{dt}\right)^2 + X + Y$$
$$= (n - n')^2\Theta(u), \text{ say.} \qquad (14)$$

Then Hill's equation (12) becomes

$$\frac{d^2q}{du^2} + \Theta(u)\cdot q = 0. \qquad (12')$$

Darwin (1909) showed that any solution of (12′) was necessarily of the form

$$q = A\cdot\exp(icu)\cdot Q_1(u) + B\cdot\exp(-icu)\cdot Q_2(u), \qquad (15)$$

where $Q_1(u)$ and $Q_2(u)$ are periodic functions of period 2π, A and B are disposable constants, and c is a constant which depends on the function $\Theta(u)$. If c is real, q, and therefore, from (11), also p, contain only sine and cosine terms in u and therefore $|p|$ and $|q|$ remain small if initially so, and the periodic orbit is stable in the ordinary sense, while if c is complex, real exponential functions of u appear in p and q as factors, so that in this case the periodic orbit is unstable.

Treating the orbit as of fixed eccentricity e, I find to the first order in e and σ

$$\Theta(u) = 1 + 2\sigma + 12e\cos\theta\cdot\cos u.$$

For most of the orbits $|\sigma|$ is considerably smaller than e, and so the constant term in Θ differs from unity by a quantity less than the coefficient of $\cos u$, in general. For this reason the method given by Brown (1936) for the determination of c cannot be used without modification since some of the quantities involved in the successive approximations contain the very small divisor σ.

Since Θ in our orbits is not a cosine series in even multiples of u Baker's (1915) solution is not applicable. Θ is a function of x_0 and y_0 and their derivatives, and these are functions of u with period 2π, so we may write

$$\Theta(u) = 1 + \theta_0 + 2\sum_{r=1}^{\infty} \{a_r \cos ru + b_r \sin ru\}$$

$$= 1 + \theta_0 + \sum_{r=1}^{\infty} \{(a_r - ib_r)\exp(iru) + (a_r + ib_r)\exp(-iru)\}$$

$$= 1 + \sum_{r=-\infty}^{\infty} \theta_r \exp(iru), \text{ say.} \tag{16}$$

The quantities $|\theta_r|$, except for θ_0, are found in general to diminish with increasing $|r|$.

Consider the case of the solution (15) in which $B = 0$. It may be written

$$q = \sum_{r=-\infty}^{\infty} q_r \exp\{i(r+c)u\},$$

so that, on equating coefficients in (12′),

$$u_r q_r = -\sum_{s=1}^{\infty} (\theta_s q_{r-s} + \theta_{-s} q_{rs}) \qquad (r = 0, \pm 1, \pm 2, \cdots) \tag{17}$$

where $u_r = 1 + \theta_0 - (r+c)^2$. Brown solved these equations by successive approximation. But in our case θ_0 is small, so that since c also proves to be small u_1 and u_{-1} are small and we lose accuracy if we divide by them. Regarding $|\theta_r|$ as of the rth order of small quantities, and solving the equations (17), except those with $r = 1$ and $r = -1$, by successive approximation up to the sixth order in q_0, q_2 and q_{-2}, to the fourth in q_3 and q_{-3}, and to the third in q_4 and q_{-4} I find, writing $v_r = 1/u_r$,

$$\begin{aligned}
q_0 = &-v_0[q_1\{\theta_{-1} - v_2\theta_1\theta_{-2} + (v_0v_{-2} + v_0v_2 + v_2v_3)\theta_{-1}\theta_2\theta_{-2} - (v_{-2} + v_3)\theta_2\theta_{-3} - v_2^2v_3\theta_1^2\theta_{-1}\theta_{-2} \\
&+ v_2v_3\theta_1^2\theta_{-3} + \cdots\} + q_{-1}\{\theta_1 - v_{-2}\theta_{-1}\theta_2 + (v_0v_{-2} + v_0v_2 + v_{-2}v_{-3})\theta_1\theta_{-2}\theta_2 \\
&- (v_2 + v_{-3})\theta_{-2}\theta_3 - v_{-2}^2v_{-3}\theta_1\theta_{-1}^2\theta_2 + v_{-2}v_{-3}\theta_{-1}^2\theta_3 + \cdots\}] \\
q_2 = &-v_2[q_1\{\theta_1 - (v_0 + v_3)\theta_{-1}\theta_2 + v_2v_3\theta_{-1}\theta_1^2 + (v_0v_2 + v_2v_4 + v_3v_4)\theta_1\theta_2\theta_{-2} - v_4\theta_{-2}\theta_3 \\
&- v_2v_3v_4\theta_1^3\theta_{-2} + \cdots\} + q_{-1}\{-v_0\theta_1\theta_2 + v_0v_{-2}\theta_{-1}\theta_2^2 + \theta_3 - v_{-2}\theta_{-1}\theta_4 + \cdots\}] \\
q_{-2} = &-v_{-2}[q_1\{-v_0\theta_{-1}\theta_{-2} + v_2v_0\theta_1\theta_{-2}^2 + \theta_{-3} - v_2\theta_1\theta_{-4} + \cdots\} + q_{-1}\{\theta_{-1} - (v_0 + v_{-3})\theta_1\theta_{-2} \\
&+ v_{-2}v_{-3}\theta_1\theta_{-1}^2 + (v_0v_{-2} + v_{-2}v_{-4} + v_{-3}v_{-4})\theta_{-1}\theta_2\theta_{-2} - v_{-4}\theta_2\theta_{-3} - v_{-2}v_{-3}v_{-4}\theta_{-1}^3\theta_2 + \cdots\}] \\
q_3 = &-v_3[q_1\{\theta_2 - v_2\theta_1^2 - (v_0 + v_4)\theta_{-1}\theta_3 + (v_0v_2 + v_2v_3 + v_2v_4 + v_3v_4)\theta_1\theta_{-1}\theta_2 \\
&- (v_2 + v_4)v_2v_3\theta_1^3\theta_{-1} + \cdots\} + q_{-1}\{-v_0\theta_1\theta_3 + v_2v_0\theta_1^2\theta_2 - v_2\theta_1\theta_3 + \theta_4 + \cdots\}] \\
q_{-3} = &-v_{-3}[q_1\{-v_0\theta_{-1}\theta_{-3} + v_0v_{-2}\theta_1^2\theta_{-2} - v_{-2}\theta_{-1}\theta_{-3} + \theta_{-4} + \cdots\} + q_{-1}\{\theta_{-2} - (v_0 + v_{-4})\theta_1\theta_{-3} \\
&- v_{-2}\theta_{-1}^2 + (v_0v_{-2} + v_{-2}v_{-3} + v_{-2}v_{-4} + v_{-3}v_{-4})\theta_1\theta_{-1}\theta_{-2} - v_{-2}v_{-3}(v_{-2} + v_{-4})\theta_1\theta_{-1}^3 + \cdots\}] \\
q_4 = &-v_4q_1\{\theta_3 - (v_2 + v_3)\theta_1\theta_2 + v_2v_3\theta_1^3\} \\
q_{-4} = &-v_{-4}q_{-1}\{\theta_{-3} - (v_{-2} + v_{-3})\theta_{-1}\theta_{-2} + v_{-2}v_{-3}\theta_{-1}^3\}.
\end{aligned} \tag{18}$$

The equations (17) with $r = 1$ and $r = -1$ are then, to sixth order,

$$\begin{aligned}
\{1 + \lambda_{-1} - (c-1)^2\}q_{-1} + \nu_{-1}q_1 &= 0, \\
\nu_1 q_{-1} + \{1 + \lambda_1 - (c+1)^2\}q_1 &= 0,
\end{aligned} \tag{19}$$

where

$$\begin{aligned}
\lambda_{-1} = \theta_0 &- (v_0 + v_{-2})\theta_1\theta_{-1} + v_{-2}(v_0 + v_{-3})\theta_{-1}^2\theta_2 + v_{-2}(v_0 + v_{-3})\theta_1^2\theta_{-2} - v_{-2}^2v_{-3}\theta_1^2\theta_{-1}^2 - v_{-3}\theta_2\theta_{-2} \\
&- (v_0^2v_{-2} + v_0^2v_2 + 2v_0v_{-2}v_{-3} + v_0v_{-2}^2 + v_{-2}^2v_{-4} + 2v_{-2}v_{-3}v_{-4} + v_{-2}v_{-3}^2 + v_{-3}^2v_{-4})\theta_1\theta_{-1}\theta_2\theta_{-2} \\
&+ v_{-2}v_{-3}(v_0v_{-2} + v_{-2}v_{-4} + v_{-2}v_{-3} + v_{-3}v_{-4})\theta_1\theta_{-1}^3\theta_2 + (v_0v_2 + v_0v_{-3} + v_{-2}v_{-4} + v_{-3}v_{-4})\theta_{-1}\theta_{-2}\theta_3 \\
&- v_{-2}v_{-3}(v_0 + v_{-4})\theta_{-1}^3\theta_3 + (v_{-2}v_{-4} + v_0v_{-3} + v_{-3}v_{-4} + v_0v_2)\theta_1\theta_2\theta_{-3} - (v_2 + v_{-4})\theta_3\theta_{-3}, \\
\nu_{-1} = \theta_{-2} &- v_0\theta_{-1}^2 + v_0(v_2 + v_{-2})\theta_1\theta_{-1}\theta_{-2} - (v_{-2} + v_2)\theta_1\theta_{-3} - v_0v_2v_{-2}\theta_1^2\theta_{-2}^2 - v_0(v_0v_2 + v_0v_{-2} \\
&+ v_2v_3 + v_{-2}v_{-3})\theta_{-1}^2\theta_2\theta_{-2} + (v_0v_2 + v_0v_{-2} + v_0v_3 + v_0v_{-3} + v_2v_3 + v_{-2}v_{-3})\theta_{-1}\theta_2\theta_{-3} \\
&+ v_0v_2^2v_3\theta_1^2\theta_{-1}^2\theta_{-2} - v_2v_3(v_0 + v_2)\theta_{+1}^2\theta_{-1}\theta_{-3} + v_2(v_{-2} + v_3)\theta_1^2\theta_{-4} - (v_3 + v_{-3})\theta_2\theta_{-4}.
\end{aligned}$$

e expression for λ_1 is obtained from that for λ_{-1} by replacing v_r by v_{-r}, and θ_r by θ_{-r}, and the pression for ν_1 is obtained from that for ν_{-1} in e same way. If q_1 and q_{-1} are not both zero, at is to say if the solution is not to be identi- lly zero, we must have

$$\begin{vmatrix} 1 + \lambda_{-1} - (c-1)^2 & \nu_{-1} \\ \nu_1 & 1 + \lambda_1 - (c+1)^2 \end{vmatrix} = 0,$$

at is to say

$$- (4 + \lambda_{-1} + \lambda_1)c^2 + 2(\lambda_1 - \lambda_{-1})c + \lambda_1\lambda_{-1} - \nu_1\nu_{-1} = 0. \quad (20)$$

om this equation c may be determined by suc- ssive approximation, beginning by calculating e u_r with $c = 0$. This was done for a selection the orbits with smaller eccentricities, and the nctions Θ and the values of c determined from em are given in Table VII.

TABLE VII. THE FUNCTION $\Theta(u)$ AND VALUES OF c

Symmetric orbits: $\Theta(u) = \Sigma A_j \cos ju$

$\theta = 0$

j	$e_0 = 0.0125$	0.05	0.10
0	1.101	1.065	1.163
1	+0.140	+0.606	+1.296
2	−0.029	+0.079	+0.463
3	−0.021	−0.011	+0.125
4	−0.014	−0.018	+0.017
5	−0.009	−0.013	−0.011
6	−0.006	−0.009	−0.015
7	−0.004	−0.006	−0.012
8	−0.003	−0.005	−0.009
9		−0.001	−0.003
c	0.0470	$0.025i$	$0.070i$

$\theta = \pi$

j	$e_0 = 0.0125$	0.0375	0.05	0.10
0	0.969	1.011	1.039	1.143
1	−0.171	−0.479	−0.638	−1.331
2	−0.012	+0.055	+0.108	+0.546
3	−0.009	−0.018	−0.032	−0.205
4	−0.006	−0.004	+0.005	+0.070
5	−0.005	−0.004		−0.026
c	0.0171	0.000	$0.018i$	$0.019i$

Asymmetric orbits: $\Theta = \Sigma A_j \cos ju + \Sigma B_j \sin ju$

	$\theta_0/2\pi = 0.3578$, $e_0 = 0.05$		0.2790, 0.10	
j	A_j	B_j	A_j	B_j
0	1.022		1.077	
1	−0.409	−0.469	−0.273	−1.171
2	−0.038	+0.121	−0.444	+0.197
3	+0.011	−0.011	−0.079	+0.164
4	−0.010	−0.002	+0.087	−0.016
5	−0.003	−0.000	+0.014	−0.070
6	−0.002	−0.001	−0.051	−0.013
7	−0.001		+0.015	±0.006
8	−0.001		+0.010	
c	0.015		0.062	

Both the symmetric orbits with $e_0 = 0.0125$ are stable, the symmetric orbits of both series with $e_0 = 0.05$ and with $e_0 = 0.10$ are unstable, and the asymmetric orbits with $e_0 = 0.05$ and $e_0 = 0.10$ are stable. The symmetric orbit with $\theta_0 = 0$ and $e_0 = 0.0375$ has a value of c too close to zero to be determined from the data available.

For orbits of larger eccentricity the successive terms in the Fourier series for Θ do not diminish rapidly and this method becomes lengthy. Darwin (1909) gave a method for the determination of c using the numerical integration of two particular solutions of Hill's equation. If $q = \phi(u)$ and $q = \psi(u)$ are two solutions such that

$$\phi(0) = 1, \quad \phi'(0) = 0,$$
$$\psi(0) = 0, \quad \psi'(0) = 1,$$

then by a simple extension of Darwin's treatment to include cases where $\Theta(u)$ is not an even function I find that

$$\cos 2\pi c = \tfrac{1}{2}\{\phi(\pi)\psi'(-\pi) + \phi(-\pi)\psi'(\pi) - \phi'(\pi)\psi(-\pi) - \phi'(-\pi)\psi(\pi)\}. \quad (21)$$

This method was applied to the asymmetric orbit with $e_0 = 0.05$. Θ was determined for values of u at 10° intervals in the range $0° \leq u < 360°$ and the solutions ϕ and ψ were found numerically. The quantity $\phi\psi' - \phi'\psi$ is independent of u and provides a check on the calculations. The values of ϕ, ψ, ϕ' and ψ' found for $u = -180°$, 0° and 180° are given in Table VIII. Hence $c = 0.011$, in fair agreement with the previous result. For the orbits with $e_0 = 0.10$, however, it was found easier to obtain results of any accuracy by the previous method than by this one.

TABLE VIII. CHECK ON THE CALCULATION OF THE ASYMMETRIC ORBITS WITH $e_0 = 0.05$

u	ϕ	ϕ'	ψ	ψ'	$\phi\psi' - \psi\phi'$
$-\pi$	−0.7566	−0.2239	0.5659	−1.1548	+1.0004
0	1.0000	0.0000	0.0000	1.0000	+1.0000
π	−0.6189	−0.3598	0.6764	−1.2230	+1.0002

The ordinary stability of these orbits may also be investigated by the use of the secular and critical terms of the disturbing function. Such an investigation, considering orbits of eccentricities up to 0.10, leads to the conclusion that those orbits of both symmetrical series are stable which have small eccentricities, those on the series $\theta = 0$ being unstable which have a mean eccentricity greater than 0.0316, those on the series $\theta = \pi$ being unstable which have a mean value of e greater than 0.0367, the value at the point

of bifurcation with the asymmetric series, and the orbits of the latter series are stable. Thus there is an exchange of stability at the point of bifurcation. The present work is in good agreement with these results.

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PARALLAX, ORBITAL MOTION AND MASS OF THE VISUAL BINARY L726–8

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Abstract. Measures on photographs taken with the 24-inch Sproul refractor over the interval 1949 to 1959 yield +″370 ± ″010 (p.e.) for the relative parallax. The double star measurements are well represented by an orbit with period 200 years and semi-axis major 5″57, appreciably larger dimensions than estimated earlier. The sum of the masses is .079⊙, confirming Luyten's deduction that these are the visual binary components of smallest known mass; the individual masses are taken as .044⊙ and .035⊙.

Introduction. L726–8, $1^h\,34^m\!.0$, −18° 28′ (1900) is a visual binary with photovisual magnitudes 12.45 and 12.95 (Luyten 1949) and spectrum dM5.5e for each of the components (Joy and Humason 1949). This star of large proper motion (3″31 in 80°5) was discovered by Luyten and its duplicity noted shortly thereafter. The rapid orbital motion observed during the first few years after the star's discovery led to estimates of orbits with semi-axes major and periods ranging from 1″7, 32 years (Luyten 1950) to 2″3, 57 years (Luyten 1954). Provisional determinations of the parallax by Steward, Yerkes, and Sproul Observatories yielded respectively the values +″56 ± ″07, +″41 ± ″04, and +″37 ± ″04 (van de Kamp and Lippincott 1950). Wagman (1956) has derived a provisional value of +″333 ± ″019. Assuming extreme values of 0″4 and 0″3 for the parallax, lower and upper limits of 0.06⊙ and 0.20⊙ were found for the combined mass (Luyten 1954). A new Yerkes value for the parallax +″381 ± ″010 appeared to narrow down the permissible range for the total mass, for which, using Protitch's (1955) orbit, 0.079⊙ was found (Luyten 1956). Thus the components of L726–8 appeared to have only half the mass of Ross 614B, whose mass, as an unseen companion was first estimated at 0.08⊙ (Lippincott 1951; van de Kamp 1954b), which value was confirmed later when the star was first seen (Lippincott 1955a, 1955b). For Ross 614B the parallax was known with high accuracy (+″251 ± ″003) and could hardly affect the calculated mass, the only uncertainty arising from error in the measured separation (1″19) with the 200-inch reflector. An upward correction to 1″4, which is perhaps the extreme permissible, would result in a value of .10⊙ for the mass of Ross 614B. The statement in 1955 that Ross 614B was the star of smallest known mass was based on the comparatively adequate accuracy of the contributing parameters: parallax, period, and semi-axis major, which for L726–8 had a fairly wide range of permissible error at that time.

Parallax. The procedure described in previous Sproul papers has been followed (van de Kamp

TABLE I. OBSERVING DATA, MEASURED POSITIONS AND RESIDUALS

poch	Date	H.A. min.	No. of pl.	exp.	Obs.	P_α	P_δ	X unit .0001 mm	Y unit .0001 mm	v_x unit .0001 mm	v_y	p
8.9026	Nov. 25	− 2	1	2	Bi	−.563	−.561	−9 6214	−2 0798	+105	−24	.2
9.6015	Aug. 8	−32	2	4	Dt	+.891	+.144	4723	0516	+101	−83	.5
.8883	Nov. 20	−10	1	1	Co	−.494	−.563	4626	0457	− 29	+32	.2
.9237	Dec. 3	−11	3	4	Co	−.656	−.550	4562	0498	+ 5	−22	1
.9401	Dec. 9	−30	1	1	St	−.720	−.535	4520	0487	+ 32	−19	.5
.9702	Dec. 20	+35	4	8	Co	−.816	−.491	−9 4529	−2 0438	− 12	+13	1
.9811	Dec. 24	+28	4	4	Co	−.844	−.470	4491	0434	+ 14	+ 9	1
.9947	Dec. 29	+ 2	1	1	Co	−.872	−.441	4436	0423	+ 50	+11	.2
1.6849	Sep. 8	+ 6	2	4	Fr	+.618	−.148	1291	−1 9902	− 27	−16	.5
.7232	Sep. 22	+ 9	2	4	Fl	+.433	−.273	1246	9926	− 12	−26	.5
.7285	Sep. 24	+17	1	1	Fl	+.404	−.290	−9 1166	−1 9881	+ 65	+21	.2
.7367	Sep. 27	0	2	4	Fr	+.360	−.315	1265	9928	− 39	−25	.5
.7423	Sep. 29	+37	2	4	Fl	+.330	−.338	1220	9866	+ 2	+41	.5
.7450	Sep. 30	−10	2	4	Fr	+.315	−.338	1256	9870	− 35	+36	.5
.7352	Oct. 3	+ 9	2	4	Fl	+.269	−.361	1204	9903	+ 10	+ 5	1
.9879	Dec. 27	− 3	2	2	Co	−.860	−.457	−9 1111	−1 9861	− 82	− 2	.5
52.6541	Aug. 27	0	2	4	Fr	+.742	−.041	−8 9573	9582	− 11	+ 1	1
.6951	Sep. 11	− 4	2	4	Fr	+.572	−.183	9551	9613	− 27	−13	.5
.7443	Sep. 29	+10	2	3	Fr	+.319	−.338	9546	9689	− 59	−73	.5
.9490	Dec. 12	− 3	2	2	Fr	−.751	−.524	9392	9568	− 51	+25	.5
.9627	Dec. 17	+ 2	2	4	Fr	−.795	−.504	−8 9352	−1 9555	− 26	+30	1
.9682	Dec. 19	− 2	2	4	Fr	−.810	−.495	9310	9591	+ 10	−10	1
53.9622	Dec. 17	+29	1	2	Wy	−.793	−.505	7579	9276	+ 14	+19	.2
.9893	Dec. 27	−10	2	3	Fr	−.861	−.454	7538	9253	+ 16	+24	1
54.0195	Jan. 7	+24	2	4	Wy	−.906	−.381	7516	9211	0	+43	1
.7402	Sep. 28	+ 4	2	4	Wy	+.342	−.325	−8 5992	−1 9043	+ 31	−10	1
.7431	Sep. 29	+32	1	1	L	+.326	−.333	6054	9102	− 33	−66	.5
.8740	Nov. 15	− 5	2	3	Fr	−.419	−.560	5892	8991	+ 48	+49	.5
.9860	Dec. 26	+26	2	4	Wy	−.854	−.461	5842	8981	− 11	+ 8	1
55.7805	Oct. 12	+10	2	4	k	+.113	−.430	4273	8757	− 9	− 4	1
.9636	Dec. 18	+30	2	4	Wy	−.797	−.503	−8 4130	−1 8704	− 5	+ 9	1
56.6488	Aug. 25	− 3	2	4	Po	+.761	−.021	2605	8397	+ 32	+23	.5
.6515	Aug. 26	−35	1	1	Po	+.753	−.031	2686	8417	− 53	+ 4	.5
.8263	Oct. 28	− 8	2	4	Fr	−.155	−.516	2489	8426	+ 15	+39	1
57.6590	Aug. 29	−31	2	4	Fr	+.726	−.057	0863	8158	+ 15	−24	.5
58.6611	Aug. 30	+ 3	4	4	Fr	+.717	−.064	−7 9124	−1 7848	+ 30	− 3	1
.9506	Dec. 13	+17	2	4	Wy	−.756	−.522	9009	7896	− 70	−47	.5
59.0079	Jan. 3	+19	2	8	Fr	−.892	−.411	8848	7830	+ 18	−18	2

Bi = Leendert Binnendijk, Co = A. Wayne Conger, Dt = Daniel F. Detwiler, Fl = Robert Fleischer, Fr = Lau-nce W. Frederick, k = Peter van de Kamp, L = Sarah Lee Lippincott, Po = William Poole, Jr., St = Alden Steven-n, Wy = Arne A. Wyller.

d Lippincott 1949). The material consists of 8 exposures on 75 plates taken on 38 nights, presenting total weight 26.5, and includes ma-rial used in the provisional parallax determi-tion. A summary of the material is contained Table I. The regular exposure time was 12 inutes. The plates were measured by the author the Gaertner machine.

Table II gives information about the reference ars as well as the dependences for 1950.0 and their annual changes. The positions of the stand-ard frame and of L726–8 hold for the approxi-

TABLE II. REFERENCE STARS

No.	Diam.	m_{pv}	x_s	y_s	Dep. 1950	ΔD/yr.
	mm		mm	mm		
1	.072	12.8	−44.67	−28.32	.407	−.00121
2	.111	11.9	+ 1.42	+19.29	.404	−.00159
3	.102	12.1	+43.25	+ 9.03	.189	+.00280
L726–8 A	.087	12.45	− 9.43	− 2.05		
B	.066	12.95				

mate epoch 1950. Due to the unfavorable observing conditions and the close separation of the components, the binary as a rule appears as a blended image which has been measured. On the nights of 1955 October 12 and 1956 October 28 the components are almost separated, and the images were measured both as a blend and as a separated double star. The position of the blend was represented formally as a weighted mean position of the components, i.e., it could be considered the photocenter of the components for a light ratio of 0.60 to 0.40 or a magnitude difference of 0.5, close to the observed photovisual magnitude difference of the components.

On the plates taken on 1958 August 30 and 1959 January 3, the components are clearly separated and yield the following relative positions:

Epoch	θ	ρ
1958.66	38°2	(2″01)
59.01	34.9	(1.84)

The position angles may be trusted but the separations are probably in need of a correction of about +″4, judging from earlier experience with Krüger 60 (van de Kamp 1937). Assuming the above light ratio, the measured positions of the components on these nights were reduced to a weighted mean "photocenter" to be included in the parallax solution.

The majority of plates are of fair quality only, principally due to the fuzzy quality of the exposures obtained at this low declination; hence the large number of nights with fractional weights. Although the faint component of L726–8, UV Ceti, is a well-known flare star, there is no evidence of flares on any of the photographs in the present parallax series.

The nightly means were represented by the following equations of conditions:

$$X = c_x + \mu_x t + \pi P_\alpha$$
$$Y = c_y + \mu_y t + \pi P_\delta,$$

where the symbols have the usual meaning; t is counted from 1960.000. A combined solution for both coordinates gives the following results, the scale factor being 1 mm = 18″87.

	mm		p. e.	weight
c_x	= −7.69724			
c_y	= −1.74435			
μ_x	= + .173343	= +3″2710	± ″0023	220.54
μ_y	= + .029027	= + .5477	± .0023	220.46
π	= + .019543	= + .3688	± .0098	11.93
p.e. 1	= ± .001787	=	± .0337	

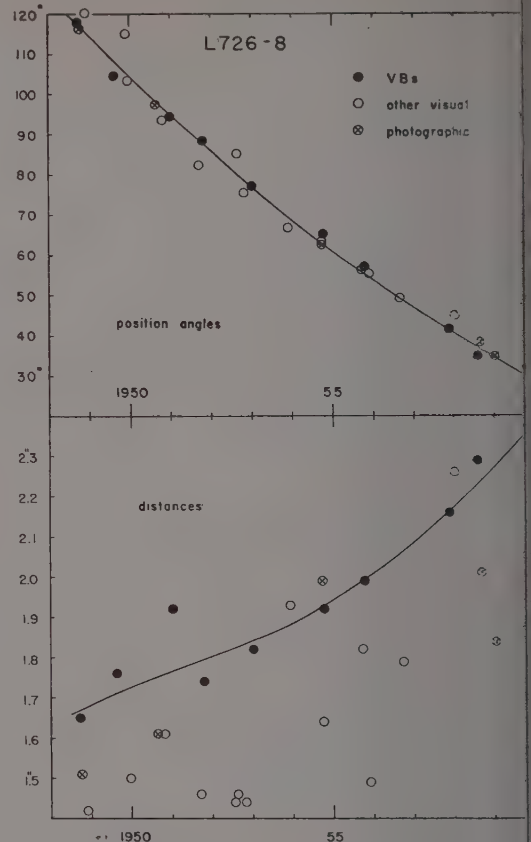

Figure 1. L726–8: Position angles and distances; observed and computed.

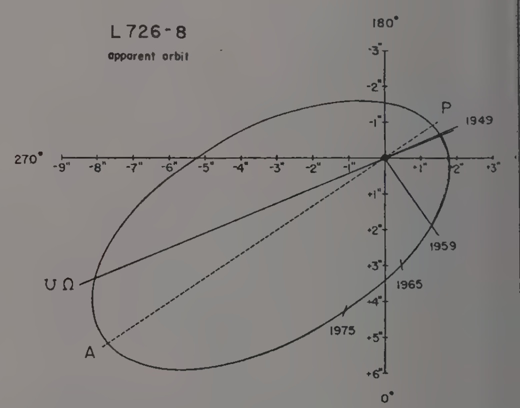

Figure 2. L726–8: Apparent orbit, based on observatio[ns] covering the sector 1949–59.

The residuals from this solution are given in Table I. The weighted mean residuals for normal places are given in Table III, together with their

TABLE III. NORMAL PLACES OF RÉSIDUALS

Epoch	Σp	Σn	v_x unit .0001 mm	v_y
1949.87	4.6	8	+21	−10
51.76	4.2	8	−18	+ 3
52.84	4.5	6	−21	− 2
54.49	5.2	7	+ 9	+12
56.70	5.0	7	− 7	+ 4

mean epoch, total weight, and number of nights. The nights of 1958 August 30 and 1959 January 3, for which the photocenter has been calculated from the measured positions of the components, are not included in this summary. The material is not sufficient to permit a determination of the mass ratio; it does not, however, indicate any striking disparity between the masses.

Orbital motion. Recent micrometer observations, kindly furnished by Dr. Van Biesbroeck and from the Lick card catalogue by Dr. Jeffers, indicate a marked increase in separation, with a corresponding decrease in angular motion. These observations are no longer satisfied by the orbital dimensions given by Luyten (1954) nor by the provisional orbit of Protitch (1955). An attempt was thus made to compute a new orbit.

The measuring difficulties of this faint object are mentioned by several observers (van den Bos 1951; Van Biesbroeck 1954; Protitch 1955; Markowitz 1956). Appreciable systematic errors are clearly present in the distance measures, both visual and photographic. It is only through the continuous series of observations by Van Biesbroeck that an analysis appears at all possible.

The short arc covered by the observations obviously still permits only a provisional orbit calculation. No trouble was encountered with the position angles but considerable adjustment of the distances was required to satisfy the law of areas. The adjusted smooth curves for θ and ρ were analyzed by Russell's (1917, 1933) elegant and effective method.* Various trials indicate that although the observations could be represented by a parabolic orbit, the best representation at this stage is reached by an orbit with period 200 years, eccentricity 0.7 and periastron passage 1948.1. With these dynamical elements, the Thiele-Innes constants were obtained from the yearly points read from the empirical curves for θ and ρ; the calculated curves show only slight and permissible deviations from the empirical curves. The resulting elements are summarized as follows:

$P =$ 200 years		
$e =$ 0.7		
$T =$ 1948.1		
$B = +4''.542$		$a = 5''.57$
$A = -3.055$	or	$i = 136^\circ.7$
$G = +2.869$		$\Omega = 112^\circ.5$
$F = +3.037$		$\omega = 344^\circ.5$

Ephemeris

Epoch	θ	ρ
1960.0	28°.9	2''.38
61.0	24.2	2.50
62.0	19.8	2.62
63.0	15.7	2.75
64.0	12.0	2.88
65.0	8.7	3.01

The position angles of all observations are satisfactorily represented by this orbit, while the distances of visual observers, other than Van Biesbroeck, generally are too small by appreciable amounts up to 0''.5. The same holds for the photographic measures (Figures 1 and 2).

It appears to be a stroke of good luck that the observations started about periastron, the first decade of observations obviously being critical, showing considerable curvature. The next few decades can add only little toward an improved orbit. The star is going to be an easy object for some time to come; the present orbit indicates a maximum separation of over 9'' near apastron!

Dynamical interpretation; mass-luminosity relation. The present parallax determination, +''.369 ± ''.010, agrees closely with Strand's value of +''.380 ± ''.011 (Luyten 1956). Assuming an absolute parallax of ''.38, the sum of the masses is 0.079⊙—exactly the same value as Luyten's, although quite different orbital elements were used. This coincidence is explained by the use of the same parallax and the observations having been made close to the positions of the node, so that the curvatures represented by different orbits do not appreciably differ (Russell 1917). With the present accuracy of the parallax, and the well determined curvature of the orbit over the past decade, it is not likely that there will be a substantial change in the calculated sum of the masses in the near future.

L726–8 furnishes a substantial extension of the fainter end of the mass-luminosity relation beyond Krü 60 and Ross 614. The mass-luminosity relation for M-dwarfs is virtually linear, the bolometric magnitude decreasing 0.5 for a

* There is an error in formula (4) in Russell's article (1933). Instead of $1/2\,bX$ read bX.

TABLE IV. MASSES AND LUMINOSITIES OF DWARF–M COMPONENTS OF VISUAL BINARIES

Name		Apparent visual magnitude	Spectrum	Absolute visual magnitude	Absolute bolometric magnitude	Mass	Log mass
Fu 46	A	10.01	M4	10.96	8.72	.31⊙	− .51
	B	10.39	M4	11.34	9.10	.25	− .60
Krü 60	A	9.82	dM4	11.84	9.60	.272	− .57
	B	11.37	dM6	13.39	10.58	.164	− .79
o^2 Eri	C	11.10	M5e	12.62	10.10	.21	− .68
Ross 614	A	11.34	dM6+	13.34	10.53	.14	− .85
	B	14.8		16.8	12.3	.08	−1.10
L726–8	A	12.45	dM5.5e	15.35	12.68	.044	−1.36
	B	12.95	dM5.5e	15.85	13.18	.035	−1.46

decrease of 0.1 in the logarithm of the mass (van de Kamp 1954a, 1958). There seems to be little objection to adopting this ratio for the components of L726–8; on the basis of their magnitude difference 0.5, their mass ratio would then be 1.26 and the individual masses $M_A = 0.044⊙$, $M_B = 0.035⊙$.

The best available data for mass and luminosity of M-dwarfs are collected in Table IV. For stars other than L726–8, the observing data have been derived from an earlier tabulation by the author (van de Kamp 1958), making use of certain new data given by Limber (1958). The bolometric magnitudes for Krü 60 A, B are those given by Limber; for the other stars, the bolometric corrections correspond to the spectral type using Limber's data for Krü 60 A, B standards. For Ross 614B, whose spectral ty[pe] is unknown, the bolometric correction (−4.[...]) was based on the absolute magnitude (Limber[...] Figure 3). The results for L726–8 appear to co[n]firm the general trend of the mass-luminosit[y] relation for M-dwarfs established thus far.

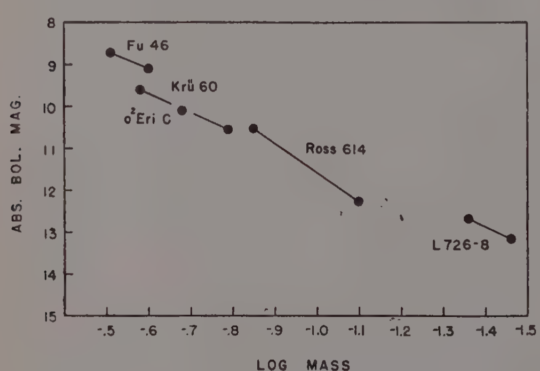

Figure 3. Mass-luminosity relation for dwarf-M components of visual binaries; the mass-ratio for L726–8 has been assumed as 1.26.

The mass-luminosity relation for M-dwar[fs] plotted in Figure 3 shows a remarkably sma[ll] dispersion which may prove to be even small[er] when improved values of the bolometric corre[c]tions become available.

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SIX VARIABLE STARS OF UNUSUAL TYPE IN SAGITTARIUS

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Abstract. The results of photographic observations on Harvard and Nantucket plates are given for six peculiar variables in VSF 193. Three of them belong to the R Coronae Borealis class. As ten per cent of all the known variables of this type have been found in VSF 193 (four stars) and twenty per cent in the whole of the constellation Sagittarius, a high concentration toward the galactic center is inferred. One probable new flare star is announced. The other two objects are apparently semi-regular. A previous provisional period for GW Sgr has not been confirmed.

In as rich and complex a star field as VSF 193 in Sagittarius it might be expected that numerous variables of the unusual types would be discovered. Six, listed in Table I, are discussed here. Two of them were previously discovered by Luyten (1927) and one by Miss Woods (1928) at Harvard; three, for which charts are given in Figure 1, are new discoveries heretofore reported

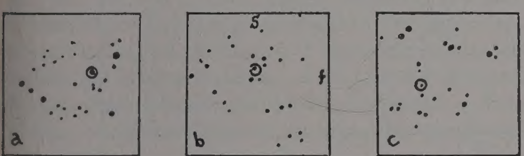

Figure 1. Environment of the new variables in Table I. Width of charts, 15′ arc.

only in abstract (Hoffleit 1958a). Of the six variables, three are apparently examples of the R Coronae Borealis type, one is probably a flare star, while the other two have semi-regular variations and may belong to the RV Tauri and RW Aurigae types. They have all been examined on at least 200 plates of the Harvard A, B and MF series taken between 1924 and 1951 with the 24-inch Bruce, 8-inch Bache and 10-inch Metcalf refractors, respectively. All but the faintest have been examined on additional plates of the Harvard patrol series and on more recent photographs taken with the 7.5-inch Cooke triplet at the Maria Mitchell Observatory. In Table I the column headed *Obs.* gives the approximate total number of photographs used and the initials of the persons making the magnitude estimates: A, Mrs. Jean Hales Andersen; F, Margo Friedel; S, Leo Schneider; and H, myself.

Observations of the first star in Table I are plotted in the top strip of Figure 2. Only two maxima are revealed, one represented by a single observation at magnitude 15.0 on J.D. 2424688, the other by 8 observations from J.D. 25475 to 25830. At maximum, fluctuations of about one magnitude have been found. The star is probably of the R Coronae Borealis type.

GU Sgr was discovered in 1927 by Luyten who ascertained the type of variation and published the light curve for the years 1889 to 1926. The light curve from over 600 Harvard and Nantucket plates taken since 1924 is given in Figure 2. Three groups of minima are found, representing more complex behavior than had previously been noted.

The third R Coronae Borealis type star, MV Sgr, had been found by Miss Woods (1928) but she published only the magnitude range from a few observations without noting the type of light variation. The recent observations, plotted in Figure 3, show two groups of minima. Because of his interest in R Coronae Borealis type stars, I called MV Sgr to the attention of Dr. George H. Herbig at Lick Observatory. He reports (private communication) that two spectrograms he obtained near maximum light indicate that the star has an extraordinary spectrum, probably an early

TABLE I. SOME PECULIAR VARIABLES IN SAGITTARIUS

Designation Sgr	Discoverer	R.A. (1900)	Dec.	Max.	Min.	Sp.	Obs.	Type
a	Hoffleit	$18^h15^m20^s$	$-24°47.'8$	13.5	15.5	—	380 H	R Cor Bor
GU	Luyten	18 08	−24 18.2	11.3	15.0	—	600 A, S	R Cor Bor
GW	Luyten	19 16	−25 05.5	13.8	15.6	—	250 F, H	RV Tau? Per. 119 days
b	Hoffleit	31 37	−20 58.3	12.1	15.7	B?	550 A	RW Aur? Semi-regular periods of 5000? and 200–400 days
c	Hoffleit	32 44	−21 48.7	12.6	15.	K5	700 A	Flare
MV	Woods	38 34	−21 03.3	12.0	15.6	B?	550 A, F	R Cor Bor

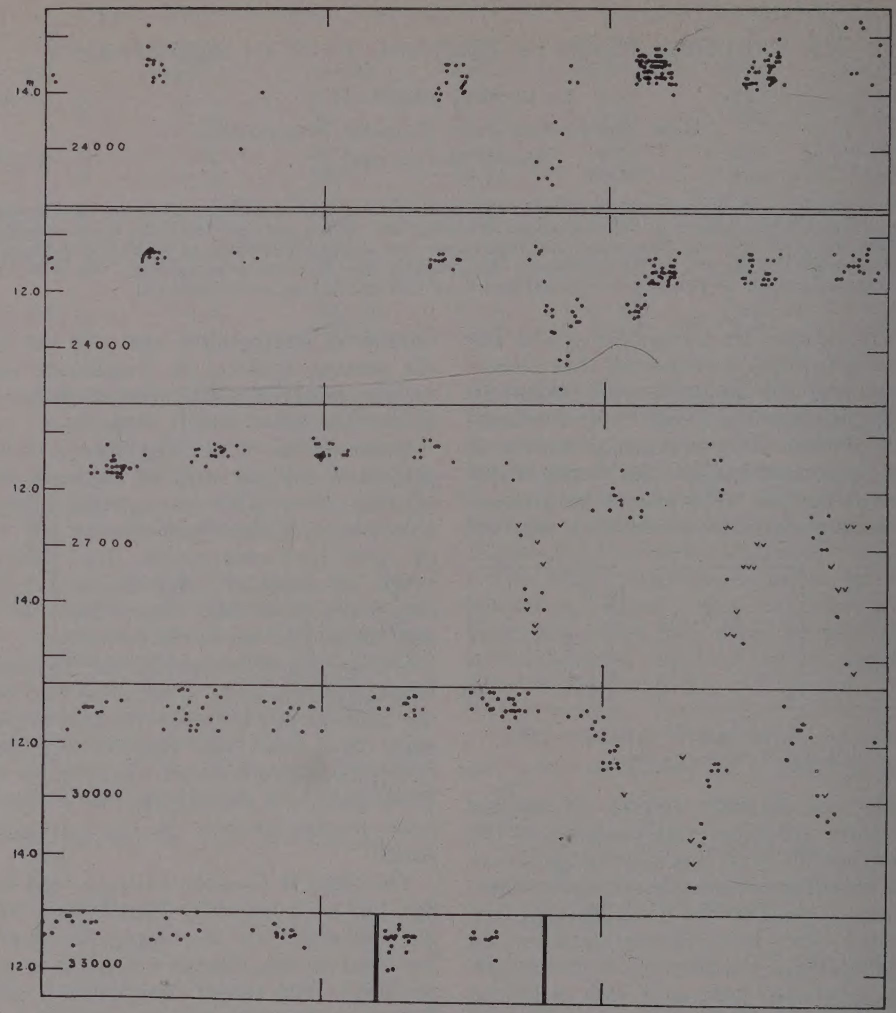

Figure 2. Two stars of R Coronae Borealis type. Top strip, Variable *a*. The other strips represent GU Sgr between J.D. 2424000 and 2434000 and, inset, J.D. 2436000–36600. Markers indicate intervals of one magnitude and 1000 days. J.D. −2400000 of beginning of each strip noted at left.

B-type, showing at low dispersion nothing but absorption lines of *He*I. Herbig adds, "The only other spectrum I know like this is Popper's (1942; 1946; 1947) helium star, H.D. 124448, which has a counterpart found by Thackeray. But neither of those is known to be variable." In view of the long duration at maximum of MV Sgr, it would not be surprising if the variability of other similar stars had failed to be discovered.

The 1958 edition of the General Catalogue of Variable Stars lists a total of 39 stars of the R Coronae Borealis type, six of them in Sagittarius. Only one of the three listed in Table I was previously recognized as belonging to this class. Thus 8 in 41, or nearly twenty per cent of the stars of this class, are concentrated in the one constellation, Sagittarius; and of these four, including V348 Sgr discussed earlier (Herbig 1958; Hoffleit 1958b), are in the 80 square-degree area of VSF 193. There may well be a few others; as yet, among the several hundred known and more than 300 unpublished variables in this field, only the stars of known large amplitude have been adequately examined for the determination of types.

A star of exceptional interest and uncertainty s to type is GW Sgr, discovered by Luyten 1927). On the basis of 140 magnitude estimates or the years prior to 1926, Luyten deduced that he star is usually at maximum and may be an clipsing variable of extraordinarily long period. le derived a provisional period of 732 days, lmost exactly two years, and recorded well-efined minima near J.D. 23622 and 24375. uyten commented that the star could conceivbly be semi-regular or of the R Coronae Borealis ypes. Margo Friedel and I examined the star on bout 250 Harvard and Nantucket plates taken etween 1924 and 1958 but could not confirm he provisional published period. We found six ntervals between minima indicating a period lose to or a submultiple of about 360 days. rom this material Miss Friedel derived a period f 179 days fitting the vast majority of our obserations. However, a night run of ten plates taken n July 30, 1951, J.D. 33858, showing the star t maximum light, falls precisely over the interal of computed minimum. I then found a modrately satisfactory period of 119 days fitting all f our observations, as shown in Figure 4. But either of the two periods satisfies the minimum bserved by Luyten on J.D. 23621–2, only a few epochs prior to the date of our earliest observation, J.D. 23908. The two computed periods are stroboscopically related $\left(\frac{1}{179}+\frac{1}{365}\approx\frac{1}{119}\right)$ and we may have simply a spurious period similarly related to the true period through the seasonal gaps in the observations. Probably the star is semi-regular, possibly of the RV Tauri type.

In Figure 5 the observations of the fourth variable in Table I, star *b*, show an apparent superposition of different cycles of variation. There are two major cycles of about 5000 days having an overall amplitude of nearly four magnitudes. At the same time, variations of the order of a magnitude or more occur in cycles of 200 to 400 days. In this respect the star appears to resemble the peculiar long-period variable, V Hydrae, which has an N-type spectrum. Dr. Herbig kindly offered also to observe this variable spectroscopically. On July 20, 1958, he found its spectrum peculiar, "the continuum being like that of a hot star with *H*-beta emission. What little can be seen of the absorption spectrum looks a little like MV Sgr." Thus it is more likely that the star belongs to the peculiar RW Aurigae than the long-period class.

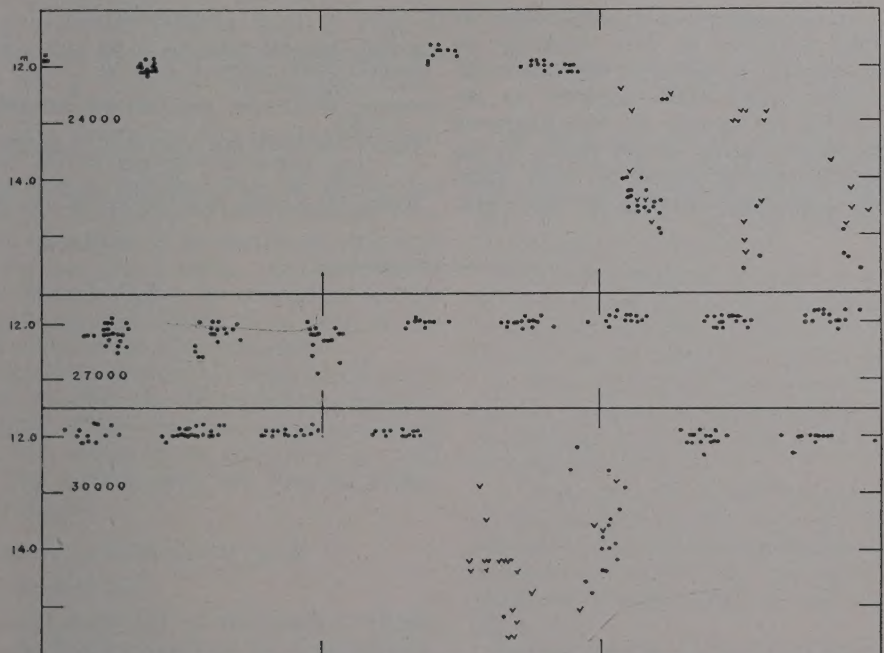

Figure 3. Observations of MV Sgr. Markers indicate intervals of one magnitude and 1000 days. At left, J.D. −2400000 of beginning of each strip.

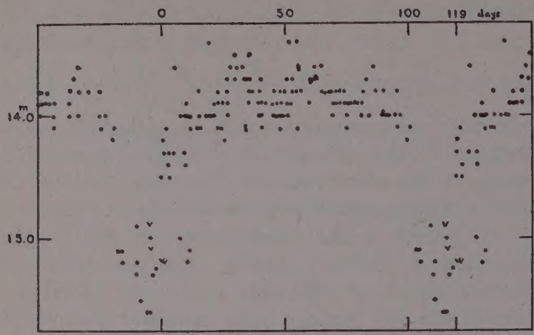

Figure 4. The observations of GW Sgr since 1924 fitted to a period of 119 days.

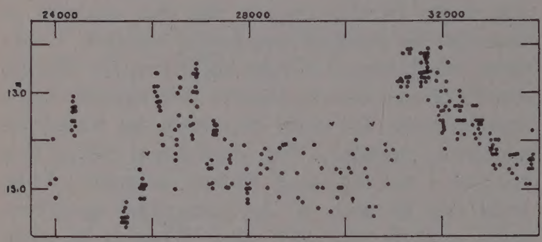

Figure 5. Observations of Variable b. Note that markers are at 2000-day intervals.

Finally, star *c* appears to be a flare star. It was carefully examined by Mrs. Andersen on nearly 700 Harvard plates. Only the one maximum has been found which occurred on the discovery plates. Fortunately the flare happened on a night when a series of five plates on the region was obtained, on August 21, 1928. Table II gives the magnitude estimates for that night. Normally the star is between 14.5 and 15.0 photo graphic magnitude. Dr. Herbig obtained its spec trum on July 14, 1958, finding it to be K5 withou emission. At the time he estimated the magni tude as about 16 visual.

TABLE II. OBSERVATIONS OF THE FLARE OF VARIABLE *c*

J.D	m_{pg}
2425480.222	14.0
.253	14.2
.285	13.6
.317	12.6
.348	12.9

A large percentage of the magnitude estimat discussed here, especially those by Mrs. Ande sen, was obtained about two years ago under grant from the National Science Foundatio Miss Friedel's work as a student assistant at th Maria Mitchell Observatory in the summer 1958 was supported by a grant from the Goul Fund of the National Academy of Sciences. M Schneider was a volunteer assistant. For all th help it is a pleasure to express my appreciatio To Dr. George H. Herbig of Lick Observator I am particularly indebted for his interest studying the spectra of our peculiar variab stars.

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